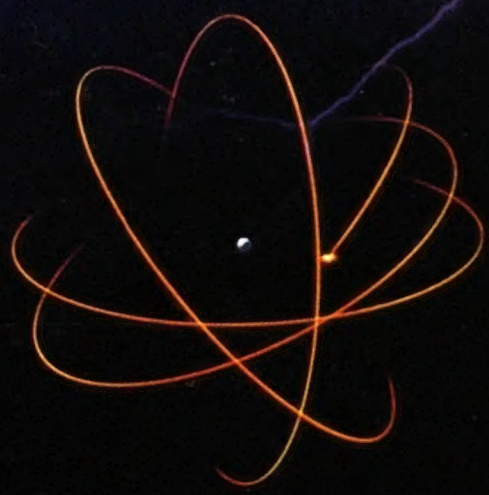
Smithsonian

May 1983



BIRTH OF THE UNIVERSE (p. 32)
Here, the atom, subatomic particles
and the primal fireworks of the Big Bang

HERE'S TO OVER-ACHIEVEMENT!

The ultimate recognition from your banker. A gold MasterCard card.

The Lands' End $13 knit shirt, now in 14 colors. A dynamite value if you can do without the "zoo."

Knit collar is taped for toughness
Taped reinforcement at shoulder seams
Sewn with strong polycore thread
Breathable 100% combed cotton "mesh" fabric
Generous cut for active comfort
Tennis tails stay tucked in

Famous-named shirts costing far more, have nothing on this 100% cotton knit—unless you count the little creatures embroidered on them to give them *cachet*. (A French word we seldom use in Dodgeville, Wisconsin.)

And incredibly, this version of our $13 knit (3 for just $37.50) is even better than the one we offered last year. For one thing, it's now in 14 colors, and it comes with a finished front placket for a cleaner, neater appearance.

Generous cut, tennis tails, fabric that breathes.

The durable 100% combed cotton these shirts are made from is treated to a "mesh" knit that air-conditions you even when you're most active. The generous cut guards against shrinkage. And both the collar and shoulder seams are reinforced with tape to protect against rip-outs.

As to style, well —with a knit collar, neat two-button placket finished underneath, hemmed sleeves and tails so generous you can forget about them —it's no wonder this is our best-selling knit shirt. Repeating, $13 (3 for $37.50) and in a 14-color spectrum.

By no means is it our only knit shirt.

Typically, once we decided to get into shirts, we followed our usual practice of providing multiple choices—in styles, colors, sizes. To begin with, for example, we offer the same quality 100% cotton knit in children's sizes at $11. (We don't know anyone else who does, at anything like that ratio of quality to price.)

Going on from there, you really should tour our latest catalog for chapter and verse on cotton pinstripes and rugby stripes, and cotton-blend solids at $14; our Jersey knit polos in 20 colors for $15; not to forget our far-ranging selection of 100% cotton rugby shirts guaranteed not to shrink out of fit. From $29 to $39.

Speaking of guarantees...

All guarantees are not created equal. And usually, the most generously worded ones deserve the most careful scrutiny.

For this reason, because ours is unconditional and applies to every item we offer, for the life of it in your keeping, we decided to express the Lands' End guarantee in two simple words:

GUARANTEED. PERIOD.

Send for our free catalog. Better still, call our toll-free number 24 hours a day and discuss your needs with one of our operators. The number: 800-356-4444 (except Alaska and Hawaii call 608-935-2788).

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of fine wool and cotton sweaters, Oxford button-down shirts, traditional dress clothing, snow wear, deck wear, original Lands' End soft luggage and a multitude of other quality goods from around the world.

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(Except Alaska and Hawaii call 608-935-2788)

May 1983

Smithsonian

Volume 14, Number 2

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A WORLD CLASS TOURING CAR
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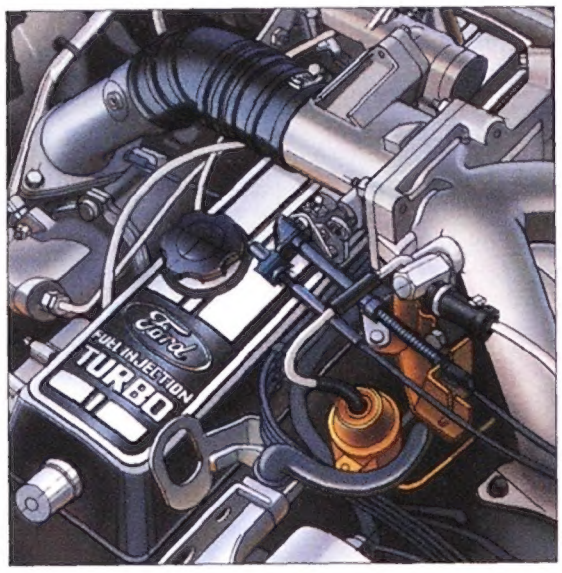
Turbo Coupe is a fuel-injected, turbocharged, five-speed Thunderbird with sophisticated running gear, performance compound tires, and seats that are more than a place to sit. A driver's car.

SOPHISTICATED POWER, JUDICIOUSLY APPLIED.

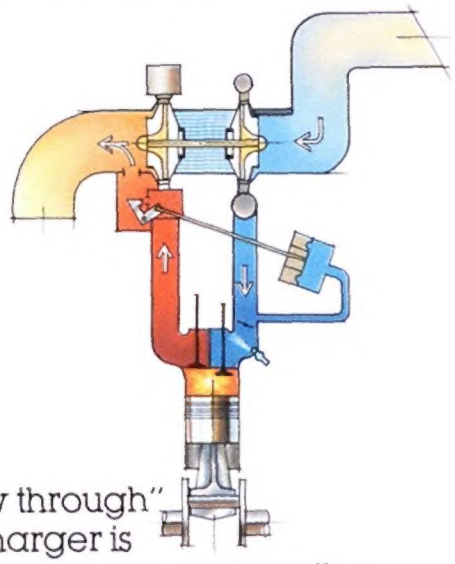
The engine.



An efficient, high-performance cross-flow head, overhead cam four-cylinder displacing 2.3 liters.

The engine employs five main bearings, forged aluminum pistons, high-temperature alloy valve materials, oil cooler and tuned intake manifold.

The turbocharger.



A "blow through" turbocharger is positioned upstream from the injectors and throttle plate.

Unlike other turbocharging arrangements, this "blow through" system pressurizes on demand. Which in turn gives the driver crisp, immediate throttle response. At full boost, around 4,600 engine RPM, the engine achieves 145 horsepower based on SAE Standard J-1349. More power than most of today's V-8s. A triumph of technology over brute force.

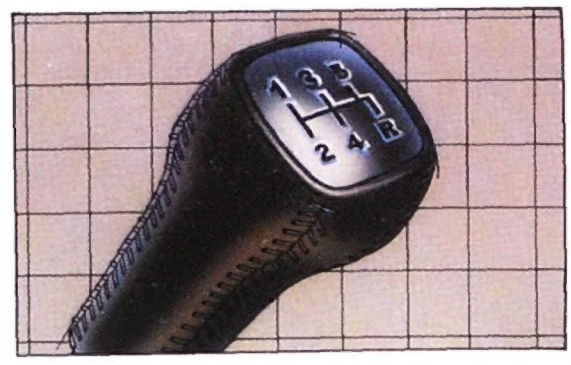
The electronic fuel injection system with EEC-IV.

The fuel injection system, fed by an electric fuel pump, is port type—with an injector ahead of each intake valve for precise metering.

The system is run by a computer called EEC-IV. A fourth-generation, state-of-the-art microprocessor-based engine control system capable of thousands of operations per second.

At one extreme, it will immediately set up air/fuel mixture and timing for a quick cold-start. At the other extreme, it will help the engine push to its safe limits. In between, it senses by the millisecond what you are asking the car to do, and balances the engine's air/fuel mixture and ignition timing for optimum power, response and efficiency.

The 5-speed transmission.



The free-revving powerplant is mated to a 5-speed gearbox. The ratios are carefully calibrated so there is a proper gear for any turn, any straightaway.

Accomplished drivers will appreciate the pedal design. The brake and accelerator pedals are positioned to facilitate true heel-and-toe downshifting.

BALANCE AND POISE ON THE ROAD.

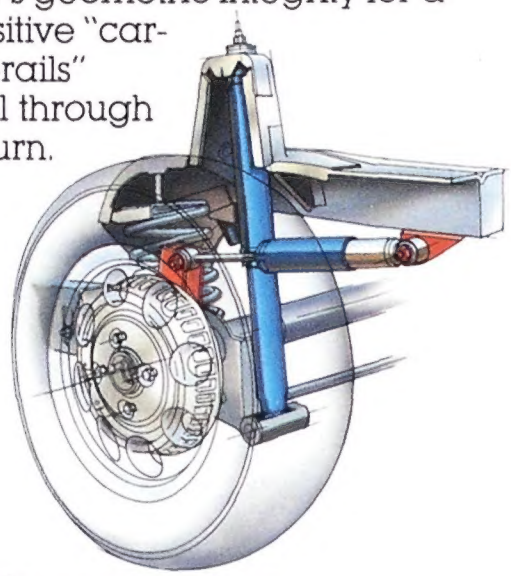
Aerodynamics/air flow management.

Turbo Coupe has one of the lowest drag coefficients of any four-passenger high-performance car in America. But more than that, Thunderbird uses the wind to help hold itself firmly on the road. It reduces lift on the hood for directional stability. Reduces lift on the rear for cornering agility. The smooth lines even lower wind noise inside the cabin. This is the difference between mere aerodynamics and what we call "air flow management."

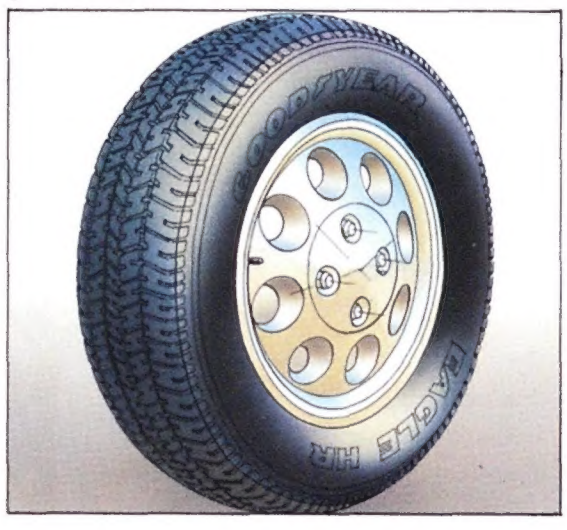
Gas-filled struts and shocks for ride and handling.

The front struts and rear shocks on Turbo Coupe contain a low pressure charge of nitrogen. This suppresses foaming of the hydraulic fluid due to rapid bumps or exuberant driving. This in turn means the ride doesn't have to be overly stiff in normal driving to be stiff enough when you, or the road, demand.

Plus two additional rear shocks for pure handling.
Turbo Coupe has a second set of rear shocks mounted in a rather unique and interesting position...longitudinally between the rear axle and the body. These help maintain the car's geometric integrity for a positive "car-on-rails" feel through a turn.



Performance tires.
Turbo Coupe mounts Goodyear Eagle P205/70HR 14 performance tires on lightweight cast aluminum wheels. The tires feature an aggressive tread pattern, performance compound rubber, and low profile design for a wide footprint. Result: excellent traction and cornering power on wet or dry pavement.



MAN. MACHINE. UNITY.

Seats you sit in. Not on.
Turbo Coupe's front seats reward the demanding driver. (1) The under thigh support adjusts. (2) The side thigh support adjusts. (3) The seat back angle adjusts. (4) The lumbar support adjusts with (5), an infinitely adjustable pneumatic actuating pump. In addition, the (6) firm side supports help hold you in place. And unlike some other high-performance seats, you don't have to be an accomplished acrobat to get in and out. Considering that a Turbo Coupe is capable of .81G in a turn, seats that support you laterally as well as up and down are essential.

Command centers.
There are three. The driving center puts steering wheel, light controls and shift lever right where your hands want them to be. The environment center clusters radio and climate control a comfortable reach away. The console center nestles electric controls for windows, seats and mirrors in a pod next to your right thigh. The car feels as if it flows from your fingertips.

And a feel that blends man with machine in a thoroughly harmonious way. A driver's car in every respect.

IN SUM.

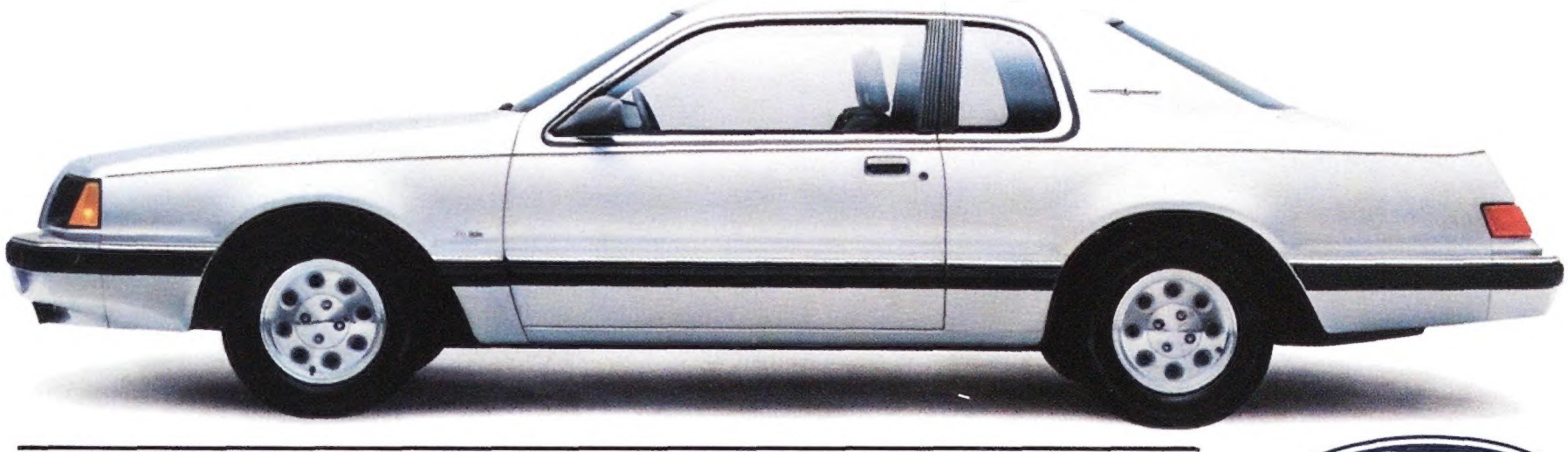
An engine so efficient it's rated at 145 horsepower on one hand and 33 estimated highway, (22) EPA estimated miles per gallon on the other.* Superb handling with no surprises.

ONE FINAL BIT OF INFORMATION.

Fewer than 10,000 Turbo Coupes are scheduled to be built this first model year. Now you know what you should do. Quickly.
Call 1-800-772-2100 for more information.

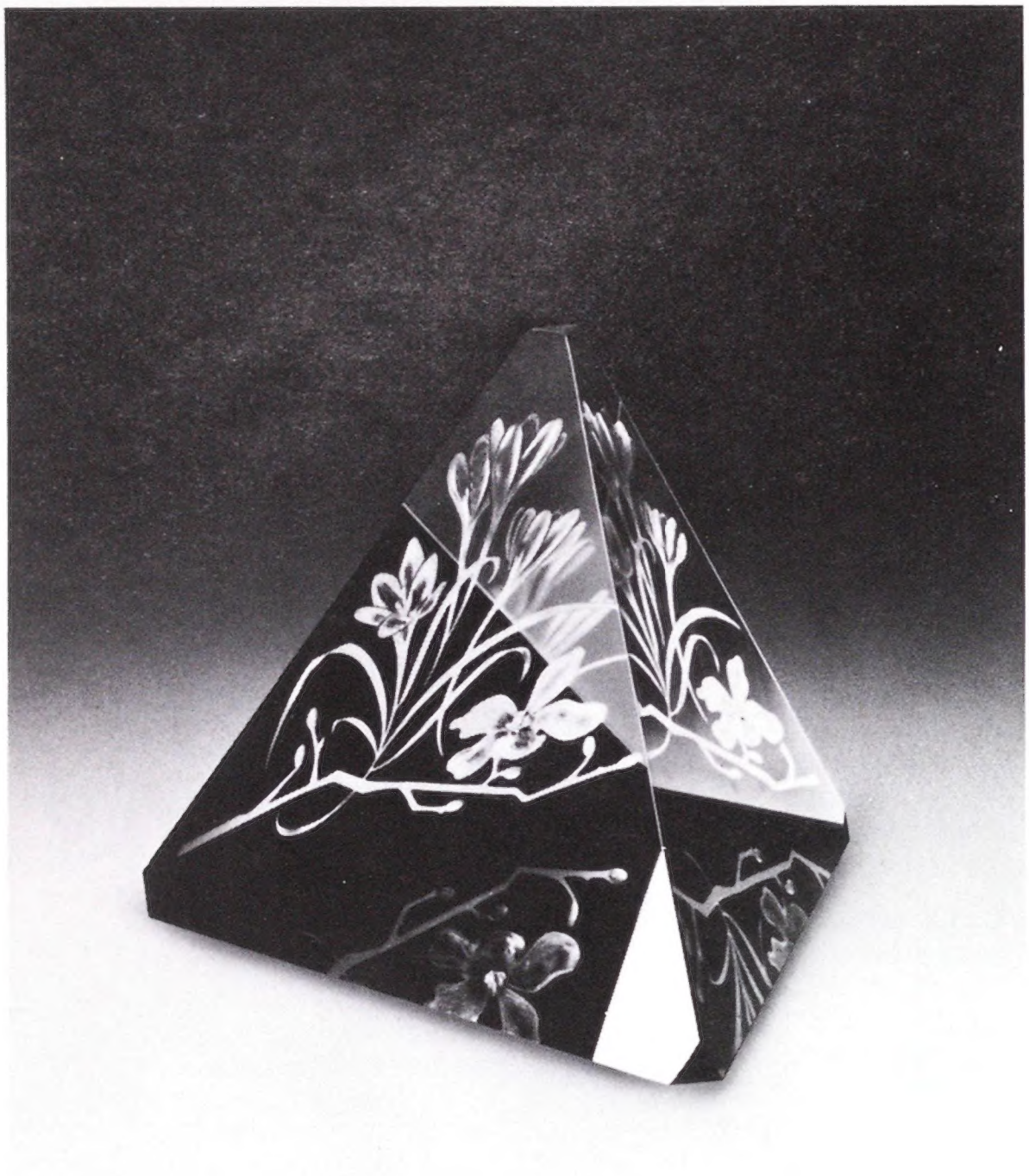
*For comparison. Your mileage may differ depending on speed, distance and weather. Actual highway mileage lower.

Get it together—Buckle up.



HAVE YOU DRIVEN A FORD...LATELY?

Ford



Tussie Mussie Secrets of Love

In Victorian times, a tussie mussie, or small bunch of flowers, was given to express an unspoken feeling. Steuben's solid crystal Tussie Mussie Collection includes the Crocus for passion (shown), Lily for coquetry, Gentian for elusiveness, and Daffodil for eternal devotion. Height 2¾". Signed Steuben. $295 each. $1,180 set of four. Steuben is part of Corning Glass Works and has been since 1918.

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Deciding whose briefcase to buy is easy. Here's the hard part.

INTRODUCING THE EXECUTIVE COLLECTION.

Making hard decisions is what separates the executive from mere mortals.

And justifies any handsome rewards that may result.

So it's truly fitting that the reward in this case is a Hartmann.

After all, Hartmanns are known for their ability to survive the relentless pressures of executive life. Without sacrificing their distinctive look of quality.

So it should be no surprise that the Executive Collection features our famous industrial belting leather or full grain leather in brown or burgundy. For a soft, supple surface that's extraordinarily resistant to scratches.

That's one reason why Hartmanns never look old before their time.

Another reason is that each case is handcrafted for strength. First, we use 12 stitches per inch rather than the mere 6-8 others use. Then we finely finish and double-lacquer the exposed edges to prevent them from separating and looking old and frayed. We also sew real spring steel into all the edges to hold them firm so they don't get dog-eared. In truth, our standards are much harder than you could ever be on our cases.

That's what makes Hartmann so easy to choose.

What makes it hard is that we've made eight cases in this Collection. Each with a different personality. Each made to fit a different executive style.

Some are big enough to carry a long report, some a brief. Some expand like a briefcase, others don't. Seven have handles, one is carried underarm.

Four have retractable handles that disappear inside for a clean uncluttered look, the other three have the famous Hartmann comfort grip. Four have optional shoulder straps. And all zippers are solid brass.

Pockets? Hartmann is famous for pockets. So you'll find innovative pocket arrangements, inside and out, throughout this Collection to match the innovative style of executives.

We could go on and on describing the unique executive features of this Collection. But the only way you'll really know which one fits your style is to see them in the flesh.

One thing we know for sure, one of them is specifically for you. Deciding which is your decision. And it's hard.

But after all, you are an executive.

hartmann

We don't cut corners.

DuPont TEFLON® soil & stain repeller

Send for a list of your nearest Hartmann dealers, Dept. 589

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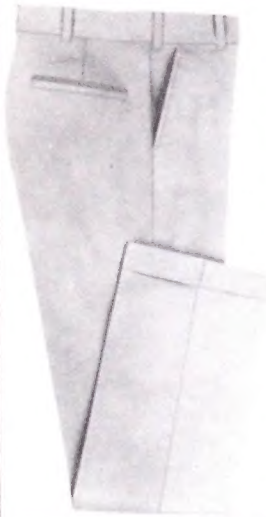
L.L.Bean®

Summer Weight Slacks



$16.50

Cool and comfortable slacks for warm weather wear. Long-wearing, lightweight poplin of 65% Dacron® polyester/35% combed cotton. Plain front style with 1¼" belt loops. Two front and two rear pockets. Well tailored for a comfortable trim fit. Machine Wash. Colors: Lt. Green. Navy. Tan. Even waist sizes: 30 to 46. Inseams: 29", 31", 33".

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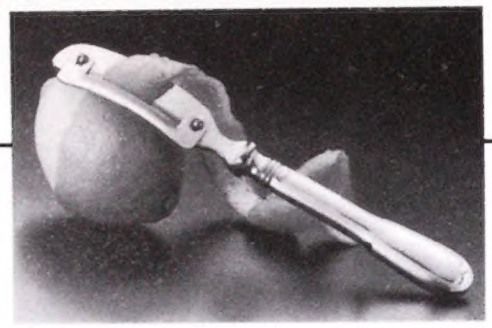

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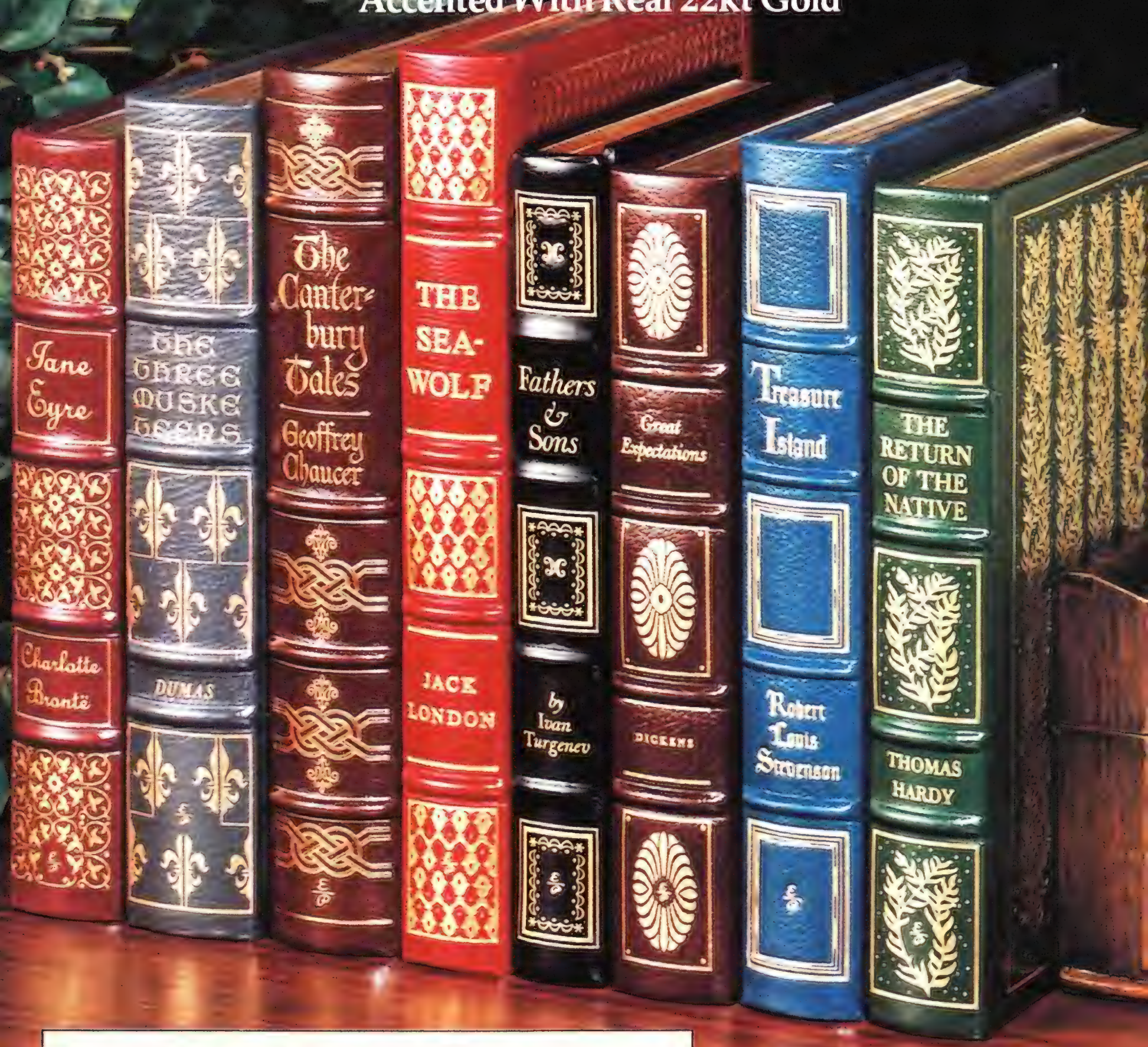

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Secretary Ripley's comments

The view from the castle

The Associates, by their generous support for our two new museums, have shown that the Smithsonian belongs to all the people

Although in some circles enthusiasm may be considered unfashionable, I am unashamed at this moment to express my joy and my pride. In the February "View from the castle," which preceded the foldout drawing of the Quadrangle, I wrote how important the two new museums of Asian and African cultures were to the Smithsonian and to America, and how money had to be raised from private citizens to match government grants. I also said that I was writing to the Associates for support of the project. My present euphoria stems from the response our appeal received. More than a million dollars! And contributions are still coming in.

We now have more than three-quarters of the $37.5 million that the Congress has asked us to raise from private sources.

While the amount is impressive, it is not the whole story. What means a great deal to me, and to the Institution, is that the asking and the giving have epitomized the very special relationship between the Associates and the Smithsonian.

It was our perception of Associate loyalty that encouraged us to look to you for support. We did not feel that you would be offended, even in these days of all too many appeals; in fact, we felt you would be offended if we did *not* ask you for support.

With the contributions—and even more personally satisfying—came many letters expressing your own belief in the Quadrangle. Some excerpts:

"I have had the opportunity to spend considerable time in Asia and Africa, and have often wished everyone could have shared my experience. Now the Smithsonian is making that dream a reality. . . ."

Or this: "At my age, which is 84, I don't expect to see it finished, but I can picture in my mind the thousands of people who will go through both museums and enjoy every step of the way."

And this one, which seems to me a symbol of global unity: "This project is particularly significant to me personally because our family is also one of builders, both literally and figuratively; my elder brother and I are architects, and my Japanese mother married my Chinese father in 1921. In 1980 I married an American with a long family history of interest in Asia and Africa." This Associate contributor thereupon entered 12 separate family members for the Associates honor roll to be kept in the Quadrangle.

For we are going to have one. Part of our plan is to send to all a tangible sign of their contribution: namely, a certificate to be treasured or displayed. But, beyond that, the names of contributors will be inscribed in a kind of "golden book" that will occupy a place of honor in the Quadrangle museums. Associate contributors will also be invited to a donor preview.

On final reflection, only one thing seems to be missing, and I propose to fill that gap now.

When the day of dedication, or the official ribbon-cutting ceremony, takes place, I would like to have Associates in attendance. When all the returns are in, they will be chosen from among the donors to stand with the rest as guests of the Smithsonian—and as representatives of what is one of our most important constituencies.

I am indeed happy this day.

S. Dillon Ripley

Lake Joseph, Ontario/Canada

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Letters to the Editor

Ground water

Dear Sir: Your articles on the Colorado River in February and on ground water in the March issue constitute a timely warning of a serious national problem.

Arizona is an oasis civilization, where we early experienced the destructive effects of ground-water overdrafting. Our state now has a comprehensive ground-water law that requires regional water plans for balanced use, prohibits development without an assured water supply and requires urban and agricultural conservation (such as ditch lining, laser leveling and mandatory water duties).

The United States, including the intermountain West, has adequate water supplies if we recognize that water is a finite resource that must be managed and conserved. Perhaps Ben Franklin said it best: "When the well's dry, we know the worth of water."

Bruce Babbitt, Governor of Arizona
Phoenix

Eyeglasses

Dear Sir: While the Cossa portrait of St. Lucy may be related to the development of the lorgnette, the connection between the saint and eyesight is well established in hagiography.

According to one legend, Lucy—a virgin martyr of the early fourth century A.D.—plucked out her own eyes as a way of warding off an overzealous suitor so she could "live for God." In another version God rewarded her with restored eyesight; undoubtedly this is the version that Cossa painted [detail above].

In any case, it is to St. Lucy that people pray who have trouble with their eyes—and need spectacles as well as miracles.

James I. Campbell
Seneca Falls, New York

Joseph Banks

Dear Sir: Your article brought to mind another set of drawings, also lost and forgotten for 200 years. *Von Reck's Voyage; Georgia in 1736* is illustrated with them.

In 1976 a Danish scholar, Kristian Hvidt, found the sketchbook in the Royal Library at Copenhagen. How they got there is a fascinating story of religious exiles and the headstrong young man whose job it was to recruit settlers and escort them to the infant colony.

His detailed journal is filled with moving accounts of daily life aboard ship and on shore. The drawings present a remarkable visual record of early Colonial life and are especially important for the light they shed on Indian customs.

The first houses ever built by Englishmen on St. Simon's Island are shown, the only known detailed representation of the earliest settlers' dwellings of Georgia.

The dwarf palmetto was depicted in his drawings 40 years before its first formal description in scientific literature. Plumegrass, *Erianthus strictus*, was not described until 1816; *Phyllanthus carolinensis*, not until 1788. Linnaeus did not name the coral snake until 1766. Yet all are here.

Jean Brown
Savannah

Russian restoration

Dear Sir: This summer a team of volunteers—headed by Dr. Shlomo Lambroza of Boston College and Boston architect Daniel Bernstein—will study St. Sophia Cathedral at Kiev, and the way in which its Ukrainian-Baroque style was integrated into Russian church architecture. (The present cathedral was completed in the 17th century.)

Your article speaks of vast destruction by the Nazis. However, in the 1930s the Soviets themselves began to destroy Kiev, one of the oldest cities in Eastern Europe. In that decade 25 churches and belfries were demolished, including the 12th-century Monastery of St. Michael, the Churches of St. Basil and St. George. The iconostases of St. Sophia were destroyed; the cathedral reopened as a state museum.

Khreshchatyk, Kiev's main avenue, was destroyed. For 20 years the Soviets maintained that retreating German troops were responsible, but in 1960 acknowledged the demolition had been carried out by Soviet agents.

Wasyll Gina
New Haven

Sled-dog racing

Dear Sir: I can't figure out why grown men and women get their kicks out of running dogs into the ground. Some of the things I read I couldn't believe. I wonder what these people would do if the roles were reversed and they were the ones made to run 20 miles, eat liver mixed with water, and sleep out in −50 degree weather. Lastly, I would like to say that I have seen a sled-dog race and that it was barbaric.

Richard Owen
Montoursville, Pennsylvania

Dear Sir: You have caught it!—the spirit, adventure and thrill of sled-dog racing, our town's winter sport.

This year the Nome Kennel Club sponsored the 75th rerun of the original All Alaska Sweepstakes between Nome and Candle. As in the past, the entry fee was $1,000, paid in gold; all rules were those used in previous races.

Dee J. McKenna
Nome, Alaska

Dear Sir: Although Togo did most of the work in rushing serum 650 miles from Nenana to Nome 54 years ago, he received precious little credit. He was retired after that extraordinary feat, having run more than 5,000 miles in his lifetime. But thanks to taxidermy, Togo will receive

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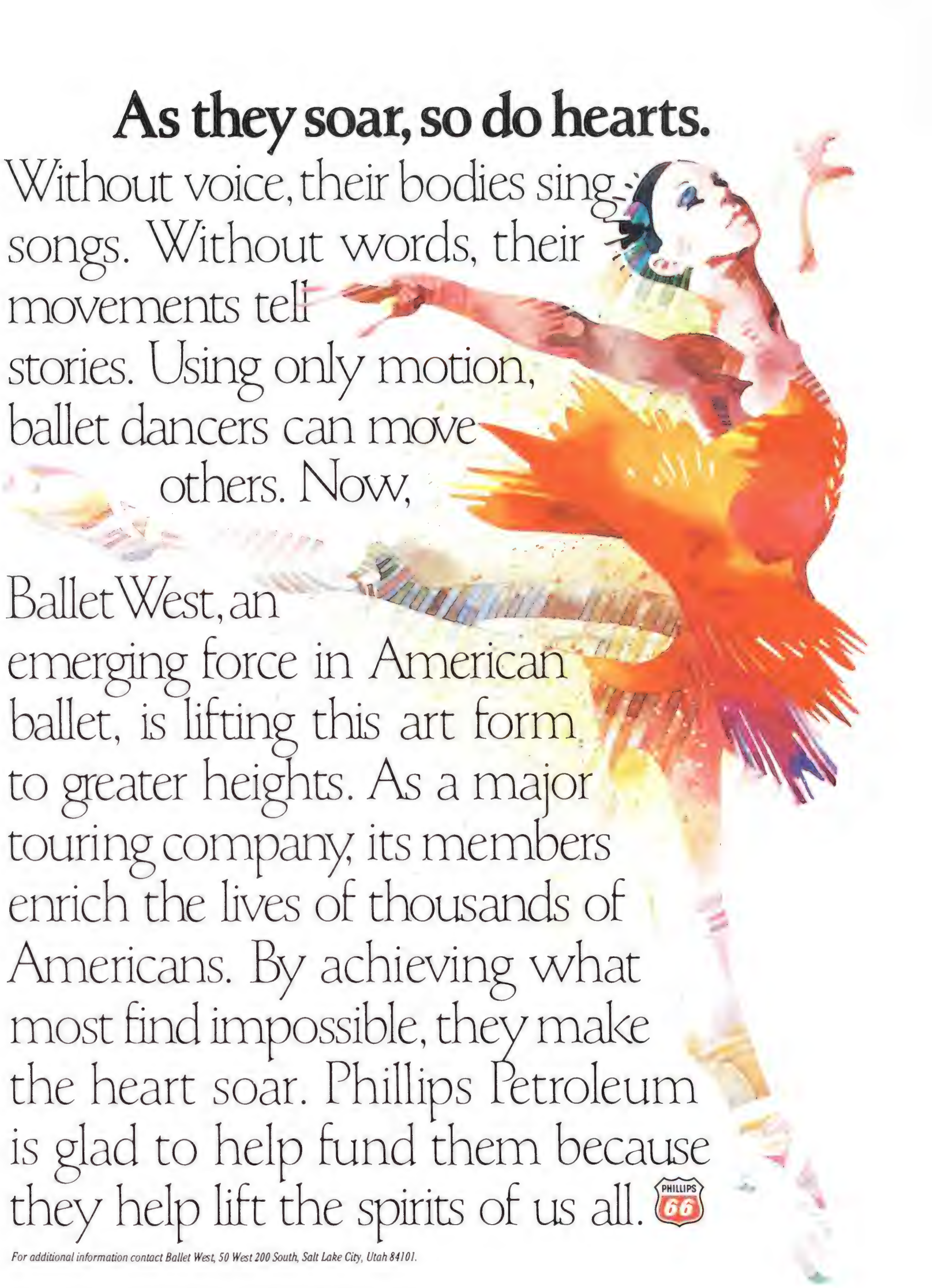

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PHILLIPS 66

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long-overdue homage. Mounted, he will be placed on display in Anchorage.
Jack Morgan
Vancouver, Washington

Dear Sir: Mr. Doherty has done a great injustice by failing to mention the splendid Samoyed, one of which was Etah, the first dog to cross the South Pole on Amundsen's expedition. The breed has not one iota of viciousness.
Joan S. Guilford and *Frisky*
Orange, California

Dear Sir: We foolishly left our March issue open to page 96 and our 130-pound malamute, Moses [below, grieving], read the musher's slurs quoted by Jim Doherty. We've told him not to be so sensitive, but despite our best efforts he has been utterly despondent, refusing even to chase squirrels, much less attack passing teams of huskies and wandering moose.

Perhaps you could help by printing the truth about these magnificent kings of the North. As anybody who has ever been owned by a malamute will attest, they are kind, gentle and sensitive—the royalty of the natural-selection breeds.
Murad Sayen
Bryant Pond, Maine

Juley archives

Dear Sir: George Kittle's article rekindled and will keep alive many memories of the years I spent with those masters of fine-arts photography. I can still smell the ever-present chemical odors in the 57th Street studio and see my father napping while Carlton faithfully carried on the work.
Paul P. Juley jr.
Santa Monica

The healthy West

Dear Sir: Dr. Daniel Drake was not unique in diagnosing death by spontaneous combustion. Charles Dickens used this gruesome death to great effect in that darkling and foggy tale, *Bleak House*, published in 1853.

In 1842 Dickens made his first journey to the United States; his travels took him west of the Appalachians. It is possible that he may have heard of, or perhaps met, Dr. Drake and learned of his peculiar theories. If so, it would have been quite typical for Dickens to keep a device like this waiting until just the right story came along.
Louis M. Buzek
Philadelphia

Dear Sir: Bil Gilbert's article omits the two most prominent testimonials for this theory—Teddy Roosevelt and Mark Twain. Teddy, suffering from bronchial asthma, invested time and money ranching in the Badlands between 1883 and 1886. Mark Twain wrote *Roughing It* in praise of the strenuous life.
Louis F. Cahn
Baltimore

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Around the Mall and beyond

A major construction project is like a heavy storm at sea. Where all was serene, mountains suddenly arise—of mud, rather than water. Passage through the area is blocked by jetsam, flotsam and lagan, and the traveler must either change course or simply lay to until the gale blows itself out and peace returns. There the similarity ceases, for at sea the end of the storm leaves the same old waters, now calm and friendly, but unchanged in character. And at a construction site—like the Quadrangle here at the Smithsonian—the turmoil ends with splendid creation; in our case, two new museums whose pavilions will rise where devastation now reigns.

Right now, that triumphant denouement seems far away indeed. The grounds look like Verdun at the height of a German artillery barrage in 1916. Surely there can be no glimmer at the end of *this* tunnel!

Yet I can attest that Smithsonian projects like this one do reach completion, that the new structures do get built, that the mud mountains do subside into landscaped and sodded grounds. The miracle has happened out at Suitland, Maryland, next door to the Paul E. Garber Facility, where ancient aircraft are revitalized and readied for their appearance onstage at the Air and Space Museum. The neighboring establishment is the new Museum Support Center (MSC), recently finished and about to begin service as a vast storage, conservation and study facility for millions of Smithsonian items.

This is the largest building in the Institution—about five acres under one roof. It consists of four bays for storage, each enclosing an area almost the size of a football field. They are set back, one from another, in echelon, and there's room for more bays to be tacked on as needed.

Paralleling this Storage Section (I think it's big enough to rate capitalization) is a low, zigzagging People Section. The two elements are separated by a street which is called, or at least which I shall call, The Street. A fiber-glass roof crowns The Street, making it part of the complex.

The MSC stands on a 15-acre lot that has been appropriately landscaped and now has many trees transplanted from the old Victorian Garden where the Quadrangle construction is going on. Smithsonian land extends beyond the grounds so that tall trees enclose the front views from the new building, shielding it from highways and housing.

If you are driving a truck transferring, let us say, thousands of invaluable animal skeletons from the crammed storage cabinets at the Museum of Natural History, you enter a loading dock at one end of The Street. Your cargo is checked and

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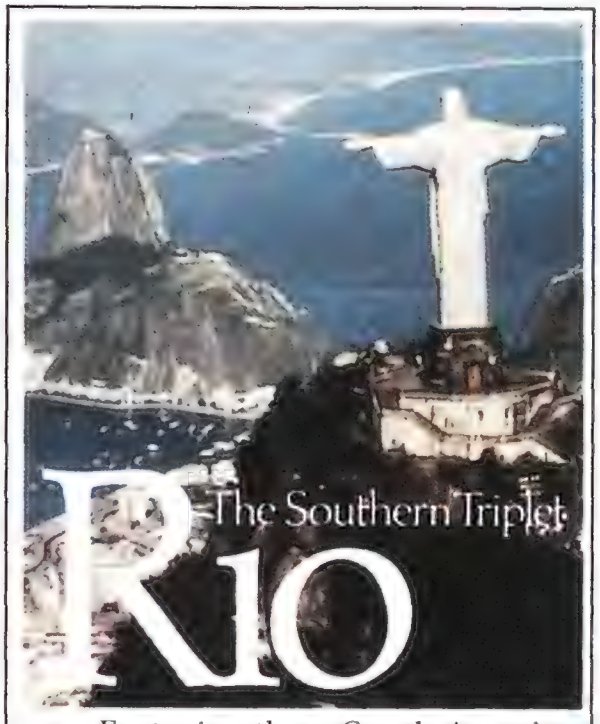

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probably fumigated. Then it is moved along The Street with its right-angle turns until it reaches the proper department—Vertebrate Zoology, in this case. From your left, the People Section, authorities appear to sort out your cargo and maybe to take some of it, by dumbwaiter, upstairs to the lab. Eventually, it all ends up in a bay, across The Street.

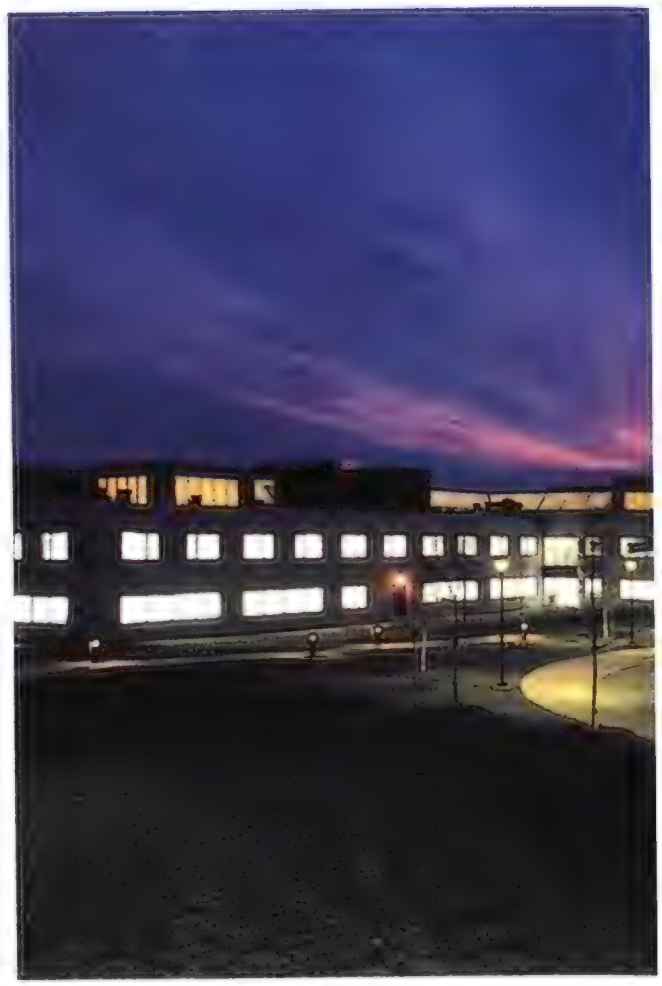
I entered the MSC as a unit of People, hence walked in through the front door of the People Section with a small group of colleagues. We passed an administration office and a food-service room with a glass wall that looked out on the grounds and the forest beyond—a pleasant vista for brown-baggers while they are munching lunch. It's one of the aspects of the place that the architects, aware of the disadvantages of working so far from Washington's urban delights, have added wherever they could. Their name for these small amenities is "compensatory chic."

A corridor leads directly through the building to The Street, and we all stepped out upon it. The cork-composition surface dampens noise and shows dirt instantly, so it can be kept clean. Remember that because of the nature of the items that are being stored and studied here, cleanliness is probably a little ahead of godliness.

Doors from the People Section open onto The Street, each leading into a Smithsonian department: Anthropology, Botany, Mineral Sciences, Paleobiology, and so on. Inside, the departments are connected only by fire doors. If a paleobiologist wants to go see a botanist, he walks out onto The Street and back in at the proper door. To help find the right place, walls of department areas have special colors. I remember that Botany is green. Something else is sort of tan.

Walls of the Storage Section, facing The Street, are a kind of pale beige, ducts are pale blue, and balcony railings, I think, a rusty red. I'm indefinite about this because the overhead lights are sodium vapor, and though they're efficient, they play hob with colors. Forty feet up, beyond the lights, are the skylight and the tubular trusswork of the roof.

Guided by Don Duckworth, planning coordinator of the project, we entered one of the bays. The impact of that enor-



Museum Support Center in Suitland, Maryland: the entrance is at center; low,

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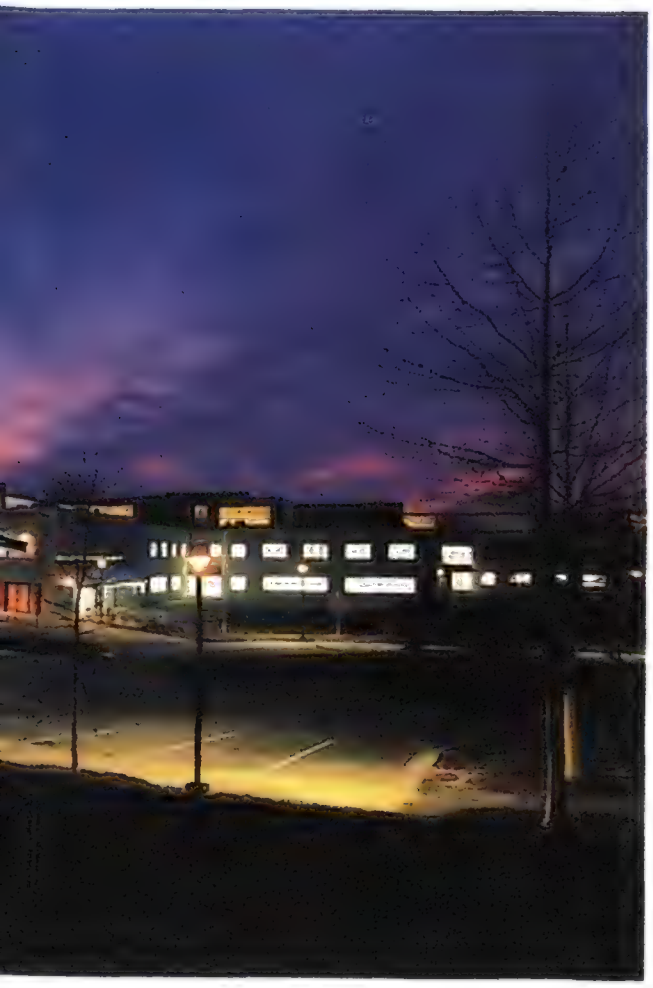

zigzagging People Section is backed by covered Street and Storage Section bays.

mous empty room, gray and faintly lit, after The Street, bright and cheerful, was remarkable. It felt like standing in the middle of a football stadium at six on a Monday morning—a thing I once did for some now-forgotten reason.

Just before the cargoes begin arriving from the Mall (a few departments are scheduled to move things here this summer), prefabricated steel floors will go into three of the pods. They will form two additional floors above the ground level, each layer packed with storage cabinets. Stairways and catwalks will allow specialists to get at the bits of bone or the shards of pottery or the mouse skulls or the bird skins or whatever is kept in the cabinets. The effect will be like visiting the stacks of your local library.

But people will be present only to remove items for study. The bays have strict temperature and humidity controls and human bodies throw them off. So once you've got your insect specimen, you take it back to the Entomology section, across The Street, and do your studying there.

We visited some of the laboratories on the upper floor of the People Section. They have tables that can be expanded; they have sinks with glass piping so that chemicals can be drained off safely; they have electric cords wound up in swiveling overhead drums, so that if you need power you simply pull the cord down and around to where you want it. When you're through, the cord winds back into the drum. I need some of those at home.

Some areas have "elephant noses"—giant vacuum-cleaner pipes for sucking up dust. Thus you can varnish a priceless Stradivarius that you've just restored, and you won't botch up the finish. One of our group tried out the entrance to a darkroom, stepping into a door in a cylinder, then turning the wall of the cylinder until the door opened into the darkroom. I guess it's old stuff to photographers, but I'd never seen that, and I wondered how many vanishing acts it would account for. We played with that, and we heaved at the heavy doors of the radiology room.

We wandered through the future library, nosed into student labs where conservation and restoration can be taught, and then sat down gratefully on the carpeted step-seats of the demonstration

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theater where lab tables can be wheeled in to face a semicircle of viewers.

I was enchanted to see the whale-rendering center, downstairs near the loading dock. It's a big tublike cooker for getting fatty products out of whale skulls. I didn't know the Smithsonian had such a thing. Now I can't wait to watch a whale being rendered.

All of this results from the Institution's old and understandable dream of easing the pressure on the storage areas back on the Mall. Our second Secretary, Spencer Baird, came to work under Joseph Henry in 1850, bringing with him two railway carloads of natural history specimens. Smithsonian facilities were jammed and have pretty much remained so. Dr. Baird struggled to get a natural history building erected on the Mall. A new national museum building finally came—27 years after his death—and was no sooner opened than it was crammed to its roof girders.

Full use of the MSC doesn't mean that great areas in (especially) the Museum of Natural History will be emptied. But there will be a decompression of the stored items. Some 62 million objects are now packed into the storage areas of the Museum of Natural History, overflowing onto galleries and into dusty attic areas. Some articles now tamped into bulging cabinet shelves deserve more isolation. So the overpopulation will ease; the makeshift storage areas will be released from a task they were never designed to do; some treasures may even get a whole shelf to themselves.

Eventually, up to 350 people will work at the MSC. What with that compensatory chic, they could do worse.

Edwards Park

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Phenomena, comment and notes

Yes, April showers still do bring May flowers, but they also leave us with naked crayfish, deformed salamanders and dead phytoplankton

When I was a child in Aruba, where it hardly ever rained except when the wind stopped in September, my sisters and I would dance when the downpours finally came. We would dash back and forth across the patio, spinning and skipping, faces and arms raised to the watery resuscitation. When the rain eased, I would go out to the coral between the bungalows and build little dams in a vain effort to hold back the tiny torrents that carried the water away so quickly. And then the sun would come out, and the nondescript thorny ground-hugging plants that eked out an existence on the coral would burst into a sea of yellow blossoms. For a day, that barren coral was a rich meadow.

On an island where it was impossible to be more than two or three miles from the sea—but an island without fresh water—I would buy North American outdoor magazines to marvel at the pictures of lakes and streams. It seemed astonishing that there could be so much fresh water in one place that people paddled their canoes on it without giving their actions a thought.

Back in the States I became equally blasé about such prodigality, but have remained acutely conscious of rain. Some of that may come from being a gardener, some from living in houses supplied by wells. The latter gives rise to anxious visions of the water table rising and falling through the rock, and makes the snows of winter not only beautiful but the hydrological equivalent of a barn bulging with hay.

Love of rain is not entirely selfish. Rain is life not only to me but to everything that lives on land—and in those lakes and streams that seemed so improbable. I can't really see air moving into the pores of a leaf to give up its carbon dioxide; the photons of sunlight that drive the process are an article of faith. But I can stand in the rain and watch the water soaking into the ground, and imagine it being taken up, rich in dissolved minerals, by uncountable rootlets. In Aruba I watered the plants around the house each day, first saturating the ground and then spraying the plant itself so the dripping leaves would provide a few seconds of

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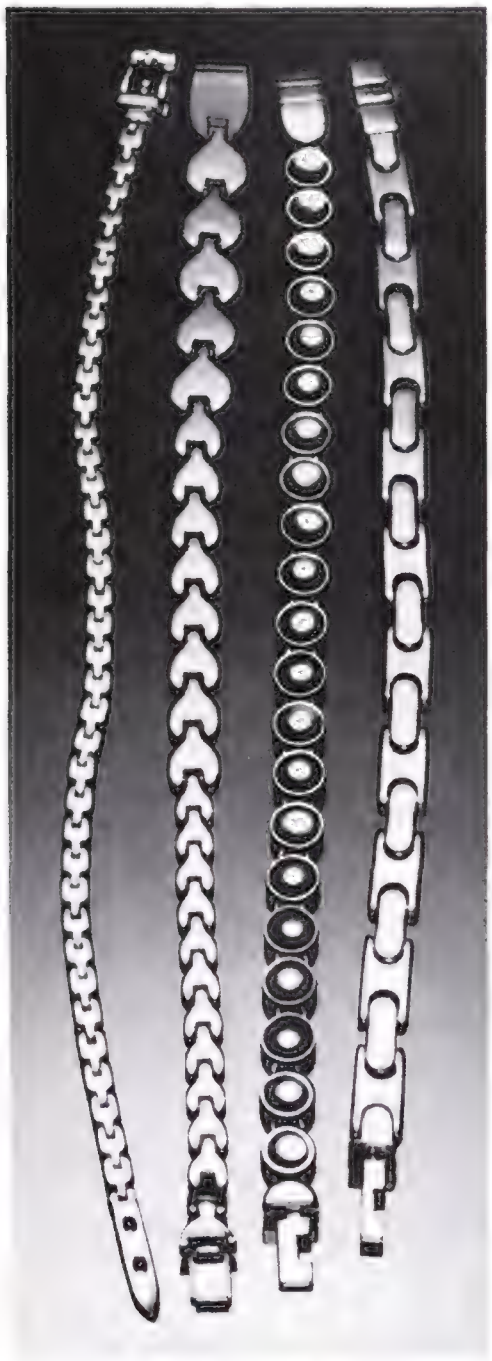

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"rain" after I had moved on. Now I walk through the woods on a rainy day when all this happens automatically, so to speak, and smell life itself.

So it is hard for me to think of rain as having become harmful to life, as a killer of those lakes and streams I loved so much. It is hard for everybody, I think, especially after a decade or more of nonstop environmental crises. But we need to comprehend this one. Our rain and snow and fog have turned increasingly acid, so acid that they are killing not just species but whole ecosystems. They are eating our buildings, stunting our forests, and even damaging our health. It is a situation that has been coming on for decades and one that will take decades to solve—when we concede there is a problem.

The problem is not new. A review in *Environmental Science and Technology* (February 1982) cites the work of John Evelyn in London in 1661. Robert Angus Smith showed that sulfuric acid was falling on Manchester, England, in 1852. But it is only in the past 20 years or so that we have realized sulfuric acid, and nitric acid as well, are falling in most of North America and Europe.

Rain has always been acidic. Carbon dioxide dissolves in water to become carbonic acid, and "natural" rain has a pH of 5.6 (the pH scale runs from 0 to 14, with 7.0 being neutral; anything below 7.0 is acidic, anything above is alkaline). Now rain in much of the eastern United States and Canada has a pH of 4.1 to 4.6. This means it is ten to 30 times as acidic as natural rain; the pH scale is logarithmic. Even though natural rain is acidic, the term "acid rain" is now used to mean anything worse than a pH of 5.6.

The damage is uneven. When acid rain falls on areas with alkaline soil, such as those rich in limestone, the acid is neutralized and the water that ends up in streams and lakes does little harm. When the same rain falls in areas where the soil is thin and where bedrock such as granite predominates, it stays acid.

Acid precipitation leaches metals from the soil. Mercury and lead flow into streams and lakes, and so does aluminum. This last accumulates in the gills of certain fish and they exude so much mucus to counteract it that it finally asphyxiates them. One study has suggested that the same aluminum inhibits calcium deposition in some songbirds, and they lay eggs with thin or missing shells. Crayfish are unable to calcify new exoskeletons. Eggs of spring peepers and salamanders do not hatch, or if they do, many of the offspring are deformed. Even the phytoplankton is killed, so that dead lakes are often unnaturally clear and blue.

In forests and croplands the effects are not so clear, but the experts are worried. Acid rain slows the decomposition of forest litter and encourages the accumula-

Troughs, buckets catch rain samples in the Adirondacks. Acidity of the water is frequently altered by contact with leaves or trunks before it hits the ground.

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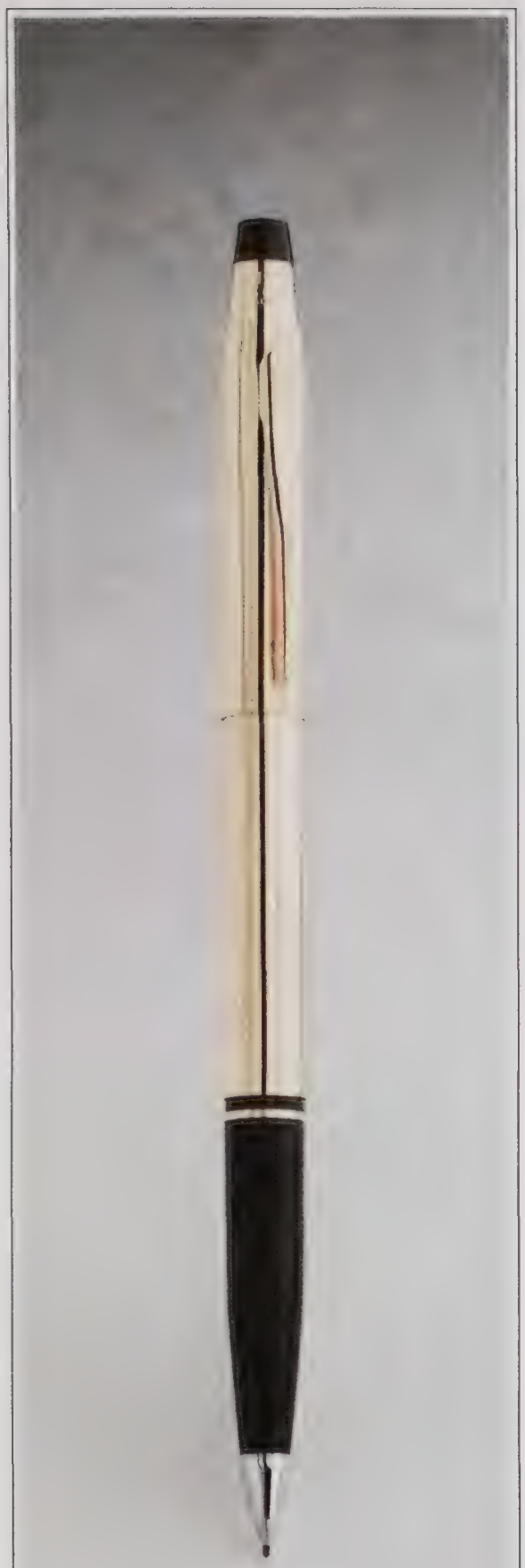

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tion of toxic metals. Nitrogen-fixing bacteria are killed. A West German study suggests it injures the feeder roots of trees.

Acid rain is real, and so are dying and dead lakes. The acid comes from sulfur and nitrogen oxides released when fossil fuels or smelt ores are burned. The United States injects more than 25 million tons of sulfur dioxide and more than 20 million tons of nitrogen oxides into the air every year. Canada adds another five and two million, respectively. We know generally where it comes from.

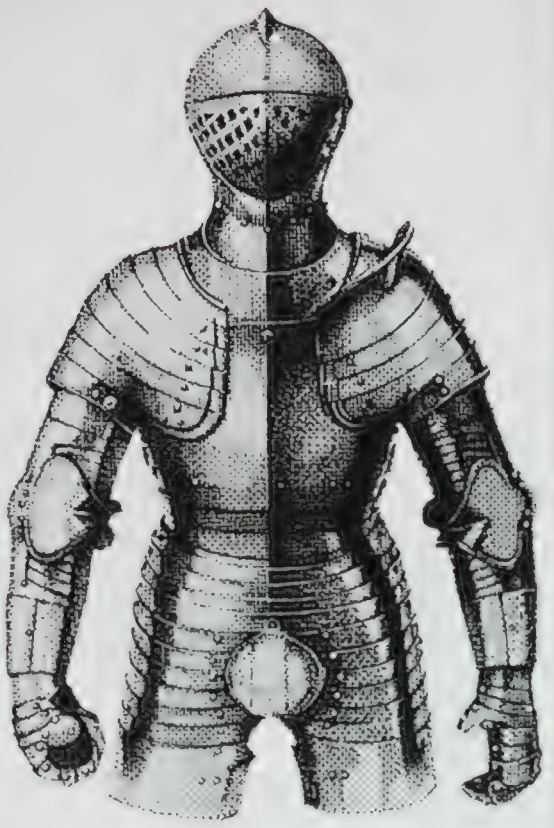
On the details, however, and on what should be done, acrimonious debate has broken out among scientists and between nations. Can anyone prove that sulfur dioxide emitted by a particular coal-fired power plant in the Ohio River Valley has anything to do with a fall of acid rain in Ontario? Can anyone prove cause and effect? The arguments sound remarkably like those that followed that first Surgeon General's report on the dangers of smoking. The circumstantial evidence is powerful, but proofs are still to come.

In the meantime, we can lime the lakes that we value most. This is actually being done in the Adirondacks and in Scandinavia. But we cannot lime whole continents. Eventually we will have to think about cutting back on those millions of tons we pump into the sky: putting in stack scrubbers, burning low-sulfur coal, washing the coal before combustion, and designing automobile engines that burn cleaner. We can even, I add in a whisper, use less energy and generate more of what we do use in more benign ways.

It has rained a lot in Washington this year. After two years of deficits, we are nearly an inch ahead of normal precipitation for the year so far. The well should be good for a while. But the well water eats faucets like peanuts. And the last time I sent a soil sample to the county extension office, they recommended 190 pounds of lime for every 1,000 square feet. The woods smell just as good after a rain, but I don't feel as good.

At a dinner party not long ago, the talk turned to acid rain. Our host said he had yet to feel that the problem was serious enough that he should add it to his list of worries. "But," replied one of the guests, an Englishman who had said little during the evening, "don't you see? We're poisoning the Earth."

John P. Wiley jr.



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Get it together–buckle up.

By James S. Trefil

First of a two-part series

Closing in on creation

Working at the limits of the large and small, science converges on the ultimate dream: the underlying unity that shapes the Universe

Ever since the human mind first grasped the immensity and complexity of the Universe, Man has tried to explain how it could have come into being. One of the oldest written attempts, the Babylonian creation epic called the *Enuma elish*, explains the beginning as the separation of land and sky. The Greeks also described such a separation, as did the Norse in their turn. The common thread is the creation of order out of chaos.

We in the 20th century have constructed our own creation epic, using the language of science rather than mythology. Our ground rules are different, but our goal is the same: to understand the early development of the Universe. The central axiom of our epic is that the Universe must have been formed by natural laws which are still discoverable today. Most scientists reject out of hand the notion that any part of this development is unknowable in principle, although they freely admit that there are still large parts of it that they do not understand. Nevertheless, this terra incognita has shrunk dramatically as scientists have discovered heretofore unsuspected ties between the study of the Universe, the largest "object" we know of, and "elementary" particles, the smallest.

Not only do these advances bring us an important new understanding of how the Universe evolved, but they bring us very close to the realization of a dream that has haunted scientists for centuries: the idea that if we could only find the right key, the Universe would be revealed to us as both beautiful and simple, with the greatest phenomena and the smallest appearing as manifestations of the same few, elegant principles. Although scientists of the stature of Albert Einstein devoted themselves to the search for a unified field theory, as these underlying principles are called today, it is only in the past 15 or 20 years that real progress has been made. Today the pieces, both theoretical and experimental, are falling into place more and more rapidly, and the solution to the ancient question might be within our grasp.

We have known since the 1920s that the Universe is expanding. Most of our galactic neighbors are receding from us, and the farther away they are the higher is their velocity. Based on the evidence available today, we can estimate when the expansion started. This initial event, known as the Big Bang, is believed to have occurred between 10 and 20 billion years ago.

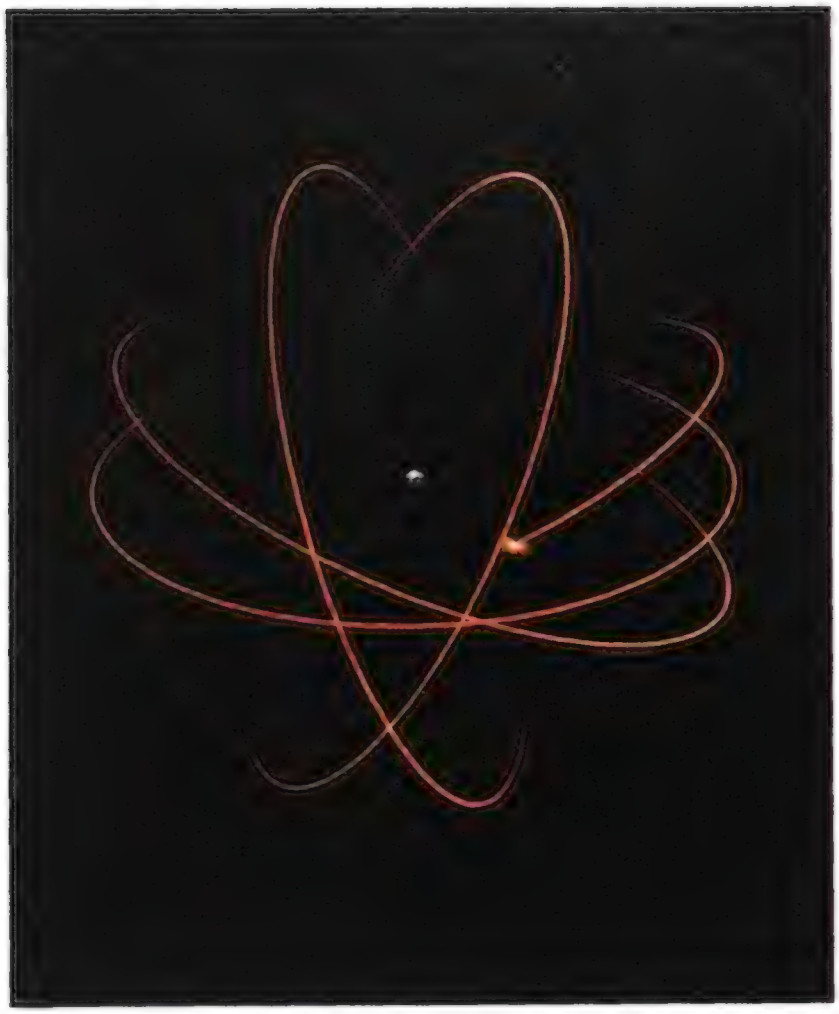
It is tempting to think of the Big Bang as something like the explosion of an artillery shell. But it is more correctly an expansion of space itself, filled with hot radiation and matter. In the "inflationary Universe" theories, the expansion went through an extraordinarily rapid phase.

Like all scientific theories, the theories about the Big Bang have to be tested. How do you prove that something was hot many billions of years ago? Well, how can you tell if there has been a fire in a fireplace recently? If you came into a room and saw coals glowing red hot, you would conclude that there had been a fire not too long ago. If the coals were a dull orange, you would still know that there had been a fire, but that more time had elapsed since the flames died down. The duller the glow, the longer the time interval. Even if the coals were not glowing, you could hold your hand out over them and see if you felt any heat.

A physicist would say you were detecting the radiation emitted by the coals as they cooled off. When you saw a glow, he would say that the radiation being emitted was ordinary visible light. When you held

As the sea of radiation (red areas) left by the Big Bang cooled, electrons were able to go into orbit around nuclei, center, and form atoms, upper left.

Photographs by Michael Freeman



After the formation of atoms, represented here in their simplest form, matter as we know it began to appear.

your hand out, he would say that you were still detecting radiation, but that now the radiation was infrared rather than visible.

In the case of the Universe, the "fire" burned between 10 and 20 billion years ago, so the "coals" are very cold indeed. The radiation they emit is no longer in the infrared, but consists of microwaves. In 1964-65, two physicists at the Bell Laboratories in New Jersey, Arno Penzias and Robert Wilson, first detected the radiation left by the Big Bang. When others duplicated the results, the Big Bang was further confirmed.

Scientists have taken the Universe as we now see it and extrapolated backward in time as far as they could, using their knowledge of the behavior of matter and radiation to do so. In this article, we will follow the same sequence, starting at the present and traveling backward in time toward the Big Bang. (Later, in the foldout time chart at the end of the article, we will show the sequence of events starting from the beginning.) We can start this process by looking at the most recent of the important events after the Big Bang: the formation of atoms.

A professor of physics at the University of Virginia, James Trefil most recently wrote The Unexpected Vista, *published this month by Charles Scribner's Sons.*

Because there is some uncertainty about the actual time at which the Big Bang occurred, it is easier to discuss events in terms of elapsed time. If we call the time of the Big Bang "Time Zero," then the formation of atoms took place at roughly Time Zero plus 500,000 years. We know that the basic constituents of atoms are nuclei, which have a positive electrical charge, and electrons, which have a negative charge and normally move in orbits around the nuclei. Because we understand the electrical force that holds the atom together, we know how much energy it would require to take an atom apart.

Before 500,000 years, the temperature of the Universe was so high that even if an electron had attached itself to a nucleus to form an atom, the other particles and the radiation in the environment would have had so much energy that as soon as the newly born atom collided with one of its neighbors or with radiation the electron would have been knocked off. Consequently, before the 500,000-year mark, the Universe would have consisted of nuclei and electrons swimming in a sea of hot radiation. When the temperature fell below the point where collisions could cause atoms to be fragmented, the electrons, drawn by electrical attraction to the nuclei, began to move into ordinary atomic orbits and stay there. From a sea of dissociated particles, the Universe "froze" into a collection of electrically neutral atoms, a state in which it has remained to this day. The term "freezing" is used advisedly, for two reasons. The process by which particles rearrange themselves into atoms is somewhat similar to the process by which water molecules rearrange themselves into crystals of ice. Second, water and ice appear to be very different things, yet in some essential way they are the same. On our journey back toward Time Zero, we will encounter many more freezings, and we will see how forces and particles, for all their apparent differences, actually have an underlying unity.

When the Universe was three minutes old

Continuing our journey backward in time, an important milestone is encountered at Time Zero plus about three minutes. The temperature of the Universe is now almost 70 times that found in the core of the sun. This is still sufficiently hot so that when a proton and a neutron come together to form a simple type of nucleus, the collisions of that nucleus with other particles or with the ambient radiation are enough to knock the two apart. This situation is analogous to the formation of atoms, where the temperature had to be below a certain point before atoms could stay together. But at three minutes past Time Zero, the Big Bang has cooled enough so that simple compound nuclei can form, first deuterium (one proton and one neutron),

then the nuclei of tritium (one proton and two neutrons), helium three (two protons and one neutron) and helium four (two protons and two neutrons). (Heavier elements, including the iron in your blood and the uranium that supplies your electricity, are created in stars after the formation of galaxies.)

Comparing the two most recent freezings, one at 500,000 years and one at three minutes, an important point emerges. In the former case we had to understand something about the electrical force to know when the freezing would occur. In the latter case, we had to know about a completely different force: the force that holds the nucleus together. Physicists call this the strong interaction. In addition, in both cases we had to know something about the constituents of the end product of the freezings: atoms made from nuclei and electrons in one case, nuclei made from protons and neutrons in the other. It is clear, then, that if we are to move much closer to Time Zero, we are going to have to learn something about the other forces which exist in nature and the constituents, whatever they may be, of protons and neutrons.

After many decades of study, physicists have been able to find only four fundamental forces in nature (pp. 38-39). One is the familiar force of gravity, another the force associated with electrical and magnetic phenomena. A third we have already mentioned; it is the strong force which holds the nucleus together. The last, the weak force, operates only at distances even shorter than the strong force. It is the force through which neutrinos, massless particles with no electric charge, react with other matter. We see it mostly in certain kinds of radioactive decay.

Protons and neutrons nestle in an atomic nucleus; they are composed of particles still more elementary.

Forces vary greatly in strength

Of these four forces, gravity is by far the least powerful. An ordinary magnet can lift a nail, even though the entire Earth is on the other side exerting a gravitational attraction. The weak force, while much stronger than gravity, is still about *1,000* times weaker than electromagnetism (which is one reason it has the name it does). The strong force, on the other hand, is about 100 times more potent than electromagnetism, as it must be to hold all of those positively-charged protons together in the nucleus. These four forces govern all known interactions between matter.

Unfortunately, the situation with the basic constituents of matter is not nearly so simple. The nucleus of an atom is not a simple static collection of protons and neutrons, but a complex, dynamic, ever-changing structure. There are protons and neutrons there, of course, but there are also many other kinds of particles which are born, last only long enough to travel from one side of the nucleus to the other, and then are reabsorbed. The study of these particles is the domain of high-energy physics, a field which has existed for only a few decades.

According to Einstein's formula $E = mc^2$, there is an equivalence between mass and energy. If there is enough energy to make up the mass of a particle or set of particles, then it will be possible to convert that energy into mass, and the particles will be created. This sort of process goes on all the time in giant accelerators, where particles are accelerated almost to the speed of light and allowed to strike other particles. Some of their energy of motion is then converted into mass and a spray of new particles is subsequently produced from "nothing."

There were no accelerators in the early Universe, of course, but we have already seen that the closer we get to Time Zero, the higher the temperature, and the faster the particles are moving. This means that as we approach Time Zero, the collisions between particles become more and more violent, and the energy involved in the collisions grows apace. As we move back in time from the three-minute milestone, then, we expect to see a lot of the kinds of particles that have been created in tiny amounts in accelerators.

Whenever a high level of complexity has been found in nature in the past, a basic underlying simplicity has

always been discovered to explain it. There are millions of chemical compounds, but they are all just different combinations of a limited number of chemical elements. There are more than a hundred elements, but all atoms are made up of different combinations of a few elementary particles. When we discover that the "few" elementary particles have grown to hundreds, it is natural to wonder whether or not there might be some underlying simplicity here as well. In 1963, the suggestion was made that what we know as "elementary" particles (a class which includes protons, neutrons and all of their short-lived neighbors in the nucleus) might not be truly elementary, but might themselves be nothing more than different combinations of still more basic entities. These truly elementary particles were called "quarks." The idea was, and is, that three quarks come together to form a proton or a neutron (p. 40).

In the original theories there were three kinds of quarks, but present theories predict that there are six, with three subspecies of each kind. Of these six, there is now direct experimental evidence for five. Although it is an open question whether quarks have ever been isolated in the laboratory, everything we know about elementary particles supports the proposition that the nuclear types are composed of quarks. We recognize, then, in addition to the components of radiation, two basic types of matter. There are particles made up of quarks, and there are electrons and their relatives. These latter are called "leptons."

Resuming our approach to Time Zero from the three-minute mark, we pass through a period in which there are no nuclei, but in which protons, neutrons, leptons and radiation interact with each other through the four fundamental forces. It is a world that is different from our own, but one in which at least the basic constituents of matter would be familiar. At about Time Zero plus a hundredth of a second, the temperature has reached 180 billion degrees F. It is now hot enough so that the hundreds of different kinds of "elementary" particles we described can be produced from the energy available in collisions. As we move back in time, the Universe quickly fills up with all manner of these objects.

The next real milestone comes someplace around Time Zero plus one-thousandth of a second after creation. Here, I will start to express time in a different way. A millisecond, for example, can be written as .001 second. But as we get closer to Time Zero, carrying all the necessary zeros will be inconvenient, so we will use what is called exponential notation. In this scheme, .001 second is written as 10^{-3} second: the "3" indicating that there are three numbers to the right of the decimal point.

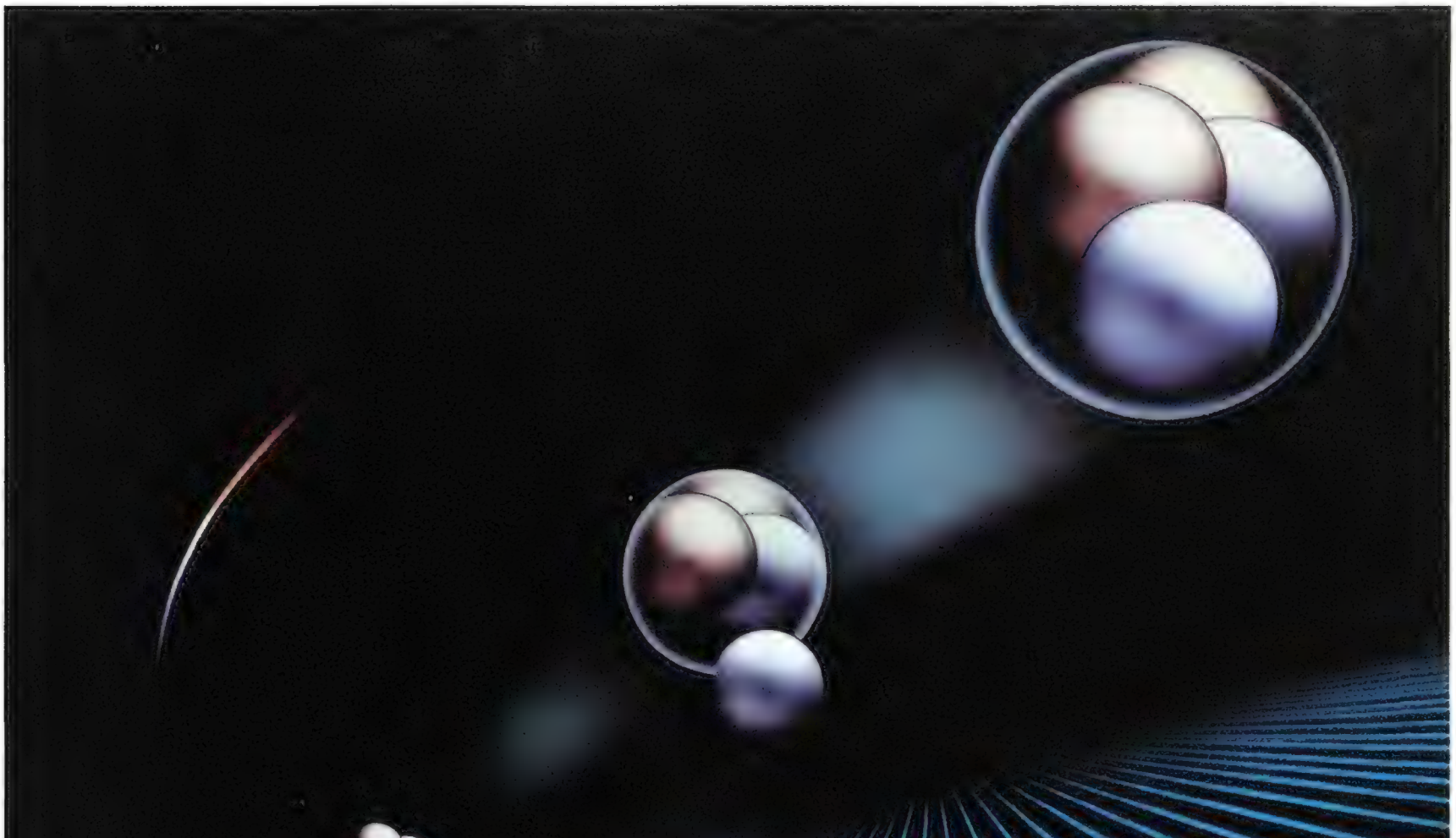
Near Time Zero plus 10^{-4} second and Time Zero plus 10^{-6} second (between one ten-thousandth and one-millionth of a second) there is another moment of transition. It was at this point that familiar particles, such as neutrons and protons, "froze" into existence; they were created as quarks began to combine in groups of three. Before this time the temperature of the Universe has climbed so high that there is too much energy for quarks to combine, and thus they exist as individual entities in their own right.

This represents an important milestone in the evolution of the Universe, and the first that requires knowledge that is not directly obtainable in our laboratories. We can, after all, watch the creation of atoms and nuclei here on Earth. We cannot watch the creation of particles from quarks for the simple reason that there are few (if any) quarks around for us to watch.

Fundamental forces begin to change

Something else important happened at this milestone. Up to now we have talked of freezings in terms of the appearance of new forms of matter, but there has been no fundamental change in the way that interactions have taken place. The same four forces that we see around us today have been in operation. Our best theoretical understanding tells us, however, that as the temperature of the Universe increases and the energy with which particles collide becomes greater, the characters of the fundamental forces themselves begin to change. In fact, from this point back to Time Zero the most important changes in the Universe deal with the freezings of the fundamental forces rather than with changes in the state of matter.

This is such a startling statement that it might be a good idea to think in terms of an analogy. Suppose we had two pieces of ground. In one there was a deep hole, while in the other there was a deep hole sur-



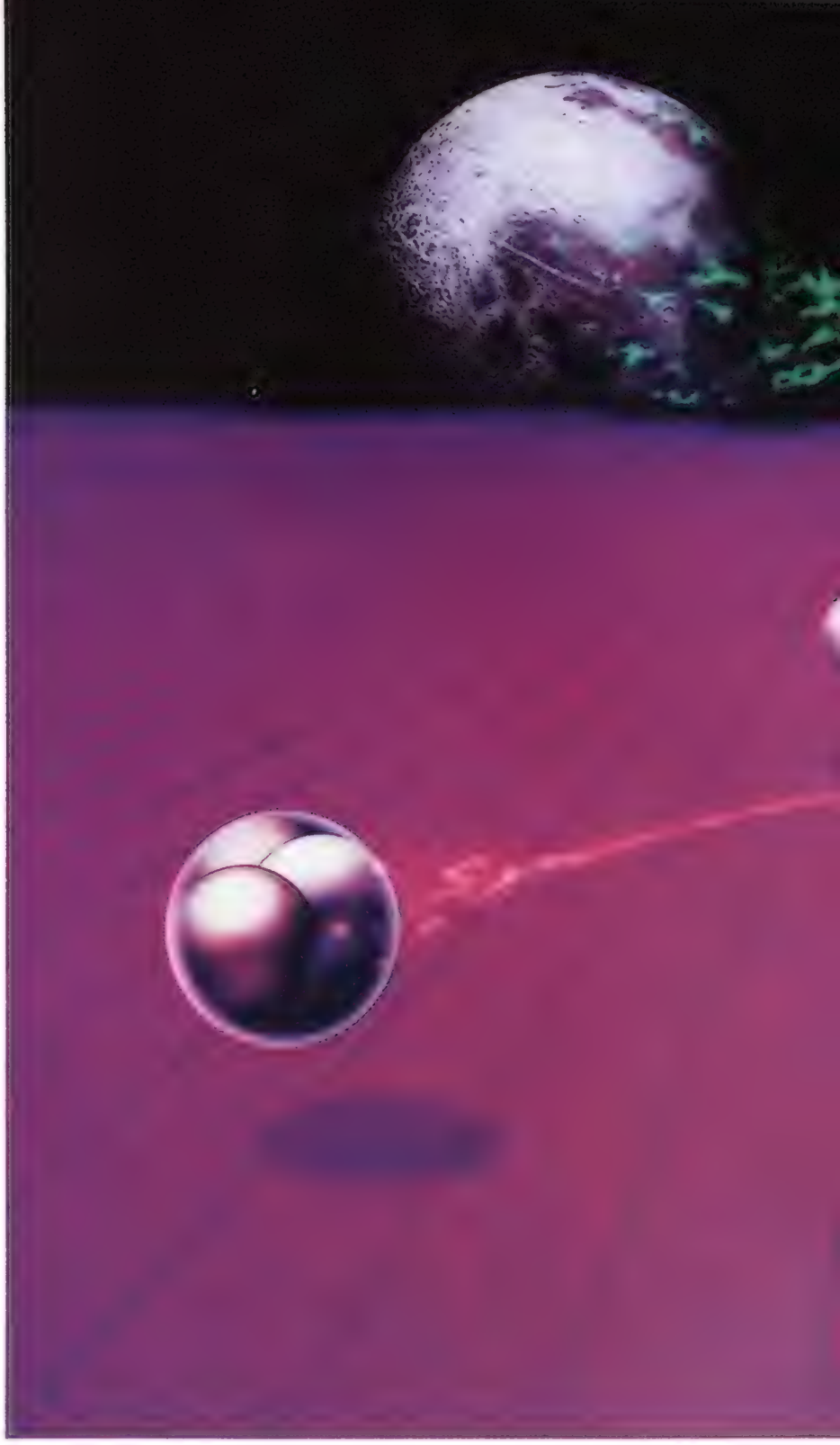
Only when the energy level in the Universe dropped below a certain level could nuclei form, as here.

rounded by a small hump. If we rolled marbles at these two targets slowly enough, we would see the marbles fall into the hole in the first case, but come rolling back down the hump toward us in the second. We would conclude, therefore, that the two spots were different in character: one would absorb the marbles, the other would repel them. In much the same way we concluded that the four forces are completely different in their effect on matter.

Suppose, however, that we rolled the marbles faster (gave them more energy). As soon as the marbles had enough energy to get over the crest of the hump, we would see a remarkable change. Now both spots would absorb the marbles and neither would repel them. We would then say that the two spots were basically similar provided that the energy of the marbles was high enough. In just the same way our theories, the only guides we have left in our approach to Time Zero, tell us that as the temperature of the Universe increases, the forces which now appear so different will exhibit a basic similarity. In the language of theoretical physics, we say that the forces become unified, and we call such an idea a "unified field theory."

The first such theory to gain widespread acceptance was developed in the 1960s by Steven Weinberg, Sheldon Glashow and Abdus Salam. It follows from their theory that at about Time Zero plus 10^{-10} second the weak and the electromagnetic forces will become unified. After this time they will appear as they do to us today: fundamentally different. But between 10^{-10} second and Time Zero, they will appear identical, so that the number of forces in nature drops from four to three: gravity, the strong and the unified electroweak force.

From the fact that this unification must take place at high energies, we can make certain assumptions



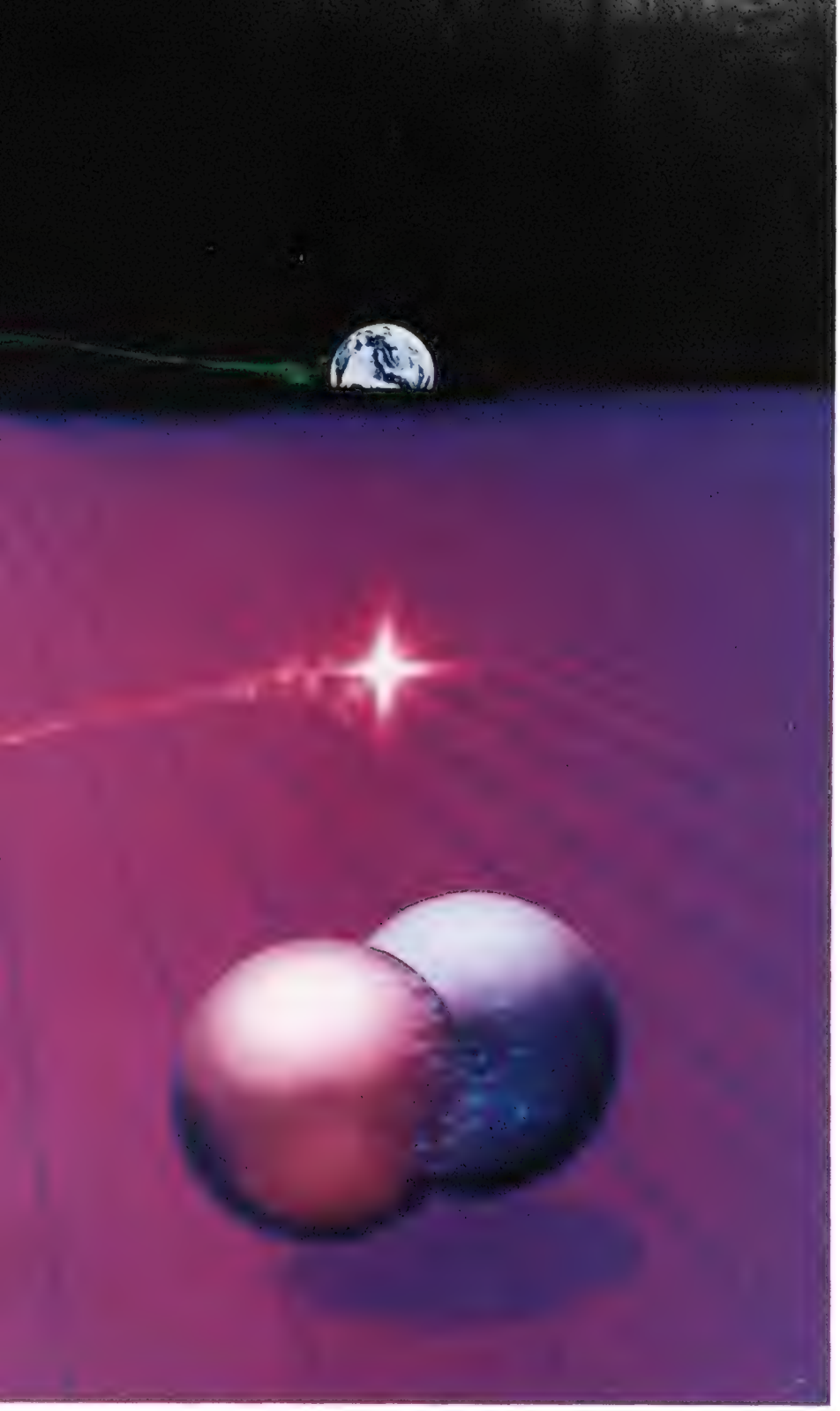
The four invisible forces that control everything in the Universe are at work here. At the lower right the strong force holds nuclear particles together. The electromagnetic force enables the proton at left

about the behavior of particles at ordinary energies. Many of these have been verified by experiment, which is why this particular unified theory enjoys the acceptance that it does. In addition, the theory predicts the existence of a set of particles, vector bosons which "carry" the weak force. Last January, a research team headed by Carlo Rubbia of Harvard University, working in Geneva, announced the discovery of two of them, the "W" particles. The particles have the properties predicted by the Weinberg-Glashow-Salam theory, and their discovery can be regarded as a major experimental verification of unification.

The next important milestone occurs at Time Zero plus 10^{-35} second, a time so small as to be almost unimaginable. The time it takes light to cross a single proton is 10^{-23} second: a trillion times longer. Now the strong force becomes unified with the electroweak, leaving us with just two fundamental interactions in nature. The theories that describe this particular process go under the name of "grand unification theories," or GUTs. They tell us about the Universe as it existed before 10^{-35} second.

And what a strange world it is! In addition to "ordinary" particles like quarks, leptons and vector bosons, the unification process itself creates new kinds of entities. The best way to understand these structures is to think of an analogous freezing process—the formation of ice on a lake. The ice layer does not usually appear everywhere on the lake at once; ice forms in several different locations and grows outward until the entire surface becomes covered. The GUTs tell us that the same thing happens with the unification of the strong force. Instead of happening everywhere at once, there are regions of space where the forces are unified. These regions grow outward until they cover the entire Universe. When the outward-growing regions come together, a boundary region is formed. In the case of water, a slightly thicker layer of ice may be formed through which a transition can be made between the direction of the crystals in one region and the direction of the crystals in the other. In the early Universe, "twists in space" could have formed in such a boundary region.

One outcome predicted by most versions of the GUTs is that these "twists in space" may appear as particles known as magnetic monopoles (p. 41). These are particles which would be analogous to the north or south pole of a magnet moving freely in space. Since every other magnet we know about must have both a north and a south pole together, these free magnetic poles would represent an entirely new form of matter. It is at this same stage that some theorists believe



and the electron at right to interact. The weak force contributes to radioactive decay, at center. And on the horizon gravity becomes the powerful link between two familiar bodies of planetary size.

the Universe underwent an extremely rapid but short-lived expansion; their scenarios constitute what is known as the "inflationary" model.

Between 10^{-35} and 10^{-43} second, theory tells us that the Universe has only two forces operating, the strong-electromagnetic-weak force and gravity. It predicts that a new sort of particle will appear, the *X*-boson. Just as the appearance of the *W* particles signaled the unification of the electromagnetic and weak forces, the appearance of this new particle heralds the unification of the strong force. It has a number of interesting properties. It is very heavy: it has roughly the same mass as the magnetic monopole. It also can help change quarks into leptons and vice versa. Whenever physicists see a situation like this in which seemingly disparate particles can be transformed into one another, they tend to believe that in spite of the apparent differences between them, the particles must be related in some fundamental way. Thus they say that quarks and leptons, in this stage of the Universal expansion, are really members of the same family.

This property of the *X*-boson also implies that if it is possible in principle for a free quark to change into some other kind of particle, then it ought to be possible for a quark inside a seemingly stable object like a proton to do so. This leads to one of the most striking features of the GUT concept: it suggests that matter in the familiar form of atoms might be inherently unstable. If one of the quarks in a proton inside an atomic nucleus in your body should suddenly undergo one of these transitions, the proton would no longer be a proton, but would disintegrate into a collection of other elementary particles.

Proton decay not a health hazard

With the proton gone, the nucleus would disintegrate just as if it were radioactive. Fortunately, the theory predicts that these decays will happen very seldom, so they do not constitute a danger to your health, but the detection of such a decay would provide a striking theoretical verification of the idea of grand unification.

When we come to within 10^{-43} second of Time Zero, however, our theoretical guidelines run out. This is the time at which we would expect gravity to become unified with the other three forces. We could, of course, describe this ultimate unification *if* we had a theory of gravity which we could apply to elementary particles. Unfortunately, there is no such theory at the present time, although developing such a theory is a major objective of theoretical physicists today. In fact, there are almost as many theories as there are authors. Those that deal with the ultimate unification, however, share two characteristics in common. They predict that when the energy is high enough, all four fundamental forces will be identical in character, and they predict that when this happens all of the particles we have described—quarks, leptons, bosons and so forth—will be interchangeable.

Just beyond the frontier, in other words, we may find a Universe which is the ultimate in simplicity. All particles are related, and one kind of force governs the behavior of matter (p. 43). If theorists are successful in producing this ultimate unified theory, and if the theory meets the experimental tests to which it will inevitably be subjected, we will have discovered that during its first 10^{-43} second of existence the Universe was as simple as it could possibly be.

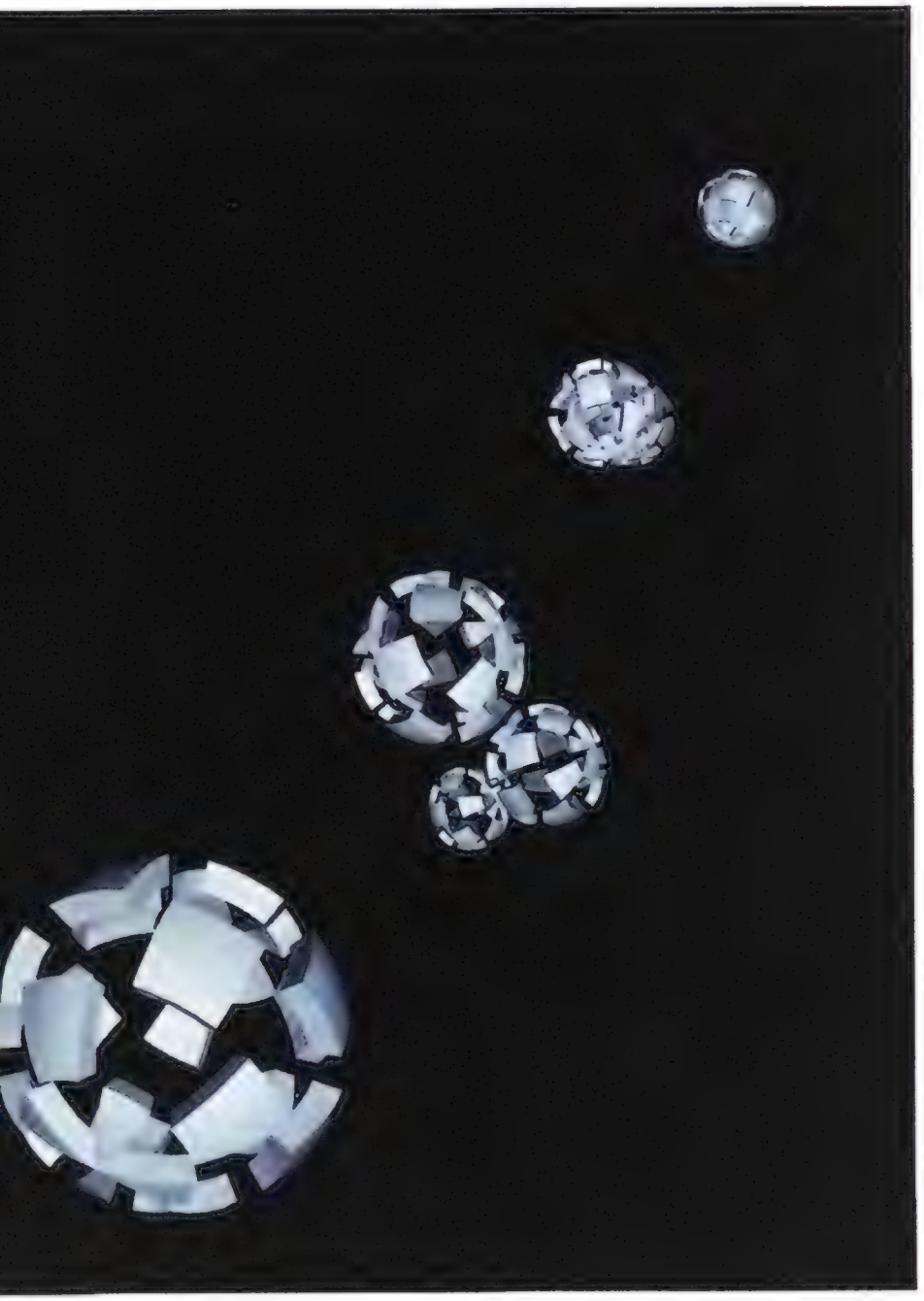
Having said this, it is important to realize that the picture of ultimate simplicity is a goal, not a reality.

There are many ways in which the present theoretical attempts could fail. For example, some physicists have argued that the traditional view in which events are embedded in space and time may fail for intervals as short as 10^{-43} second, and that our notion of time itself may have to be rethought. Whether this sort of revolutionary change is necessary remains to be seen, of course, but the fact that people are thinking about it illustrates dramatically how far we have come in our quest for the ultimate beginning.

The picture that the grand unification scheme gives us of the early development of the Universe is doubtless fascinating, but you are probably beginning to wonder whether the whole business isn't something like a fairy tale. Isn't all this discussion of unseen quarks and *X* particles a little like talk of unicorns?

Actually it is not, because it turns out that the new theories, in addition to telling us about the early Universe, have very definite statements to make about things that can be measured here and now on Earth. Theory tells us that events which occurred readily at the high temperatures just after the Big Bang have not completely disappeared during our relatively frigid times. They still occur, albeit much less frequently, so that we can test the theory by looking for them.

Perhaps an analogy will help to make this point. Suppose we wanted to find out if a piece of wood contained sulfur. We could burn it and see if sulfur is released. But suppose we could not find a way to ignite the wood. We could still get the answer by a more roundabout and less convenient method. We could wait while the wood rotted at normal temperatures. During the rotting process, sulfur could also be emitted into the air, and if we were patient and had very sensitive equipment, we could detect it. Persons trying to test grand unification are in the same position as someone who cannot light the wood. We cannot produce the temperatures characteristic of the Big Bang, and we probably never will. Our alternative is to wait and watch for rare events. The most spectacular such event would be the decay of a proton, which would help to verify the unification theories.



Conceived here as something of a Chinese puzzle, quarks come together, center, to form a proton. Protons and neutrons are all composed of quarks.

A strategy for seeing rare events

The proton is a basic building block of matter. Asserting that it can disintegrate spontaneously is equivalent to saying that the material world itself is only temporary. You need not worry, however, that this magazine will disappear before your eyes (or vice versa). The fact that the world seems stable, and the fact that the Universe has been around for 15 billion years or so, both indicate that if the proton can decay, it does so very rarely. The theories tell us that if we want to write the number of years it will take for half of the protons in the Universe to disappear, we would write a 1 followed by something like 31 zeros—a number which physicists abbreviate by calling it 10^{31} years. This number bears the same proportion to the age of the Universe as the national debt to a ten-millionth part of a penny. On the face of it, it would seem to be impossible to detect an event that occurs so rarely. But such pessimism ignores the cleverness of experimental physicists.

For if protons average 10^{31} years to decay, it follows that in a collection of 10^{31} protons one will decay in any given year. This last is about 1,000 times the number of protons in your body. The scheme, then, is to set up delicate instruments to monitor a large collection of atoms and see if evidence for a proton decay turns up (p. 51).

Last January, scientists at the largest proton-decay

experiment announced the results of their first experimental run. No decays were seen in 80 days of running time. The experimenters concluded that the proton, if it decays at all, must do so with a lifetime of almost 10^{32} years. This is a bit longer than predicted by original theoretical calculations, but still within the range that theorists could accommodate.

It is fair to say that the success or failure of these experiments will play a large role in the future development of the grand unification idea. As one physicist put it, "It seems that now everyone is just waiting around for a proton to decay."

There were many particles present in the early part of the Big Bang that are not around today. Some, like the vector and *X*-bosons, are unstable. Such particles disappear rapidly once the temperature falls below the level needed to replenish their population through collisions. Others, like monopoles and quarks, are not normally seen for different reasons. Quarks, for example, can condense into protons and neutrons in groups of three after 10^{-5} second. On first glance, we would expect none to survive in their free state.

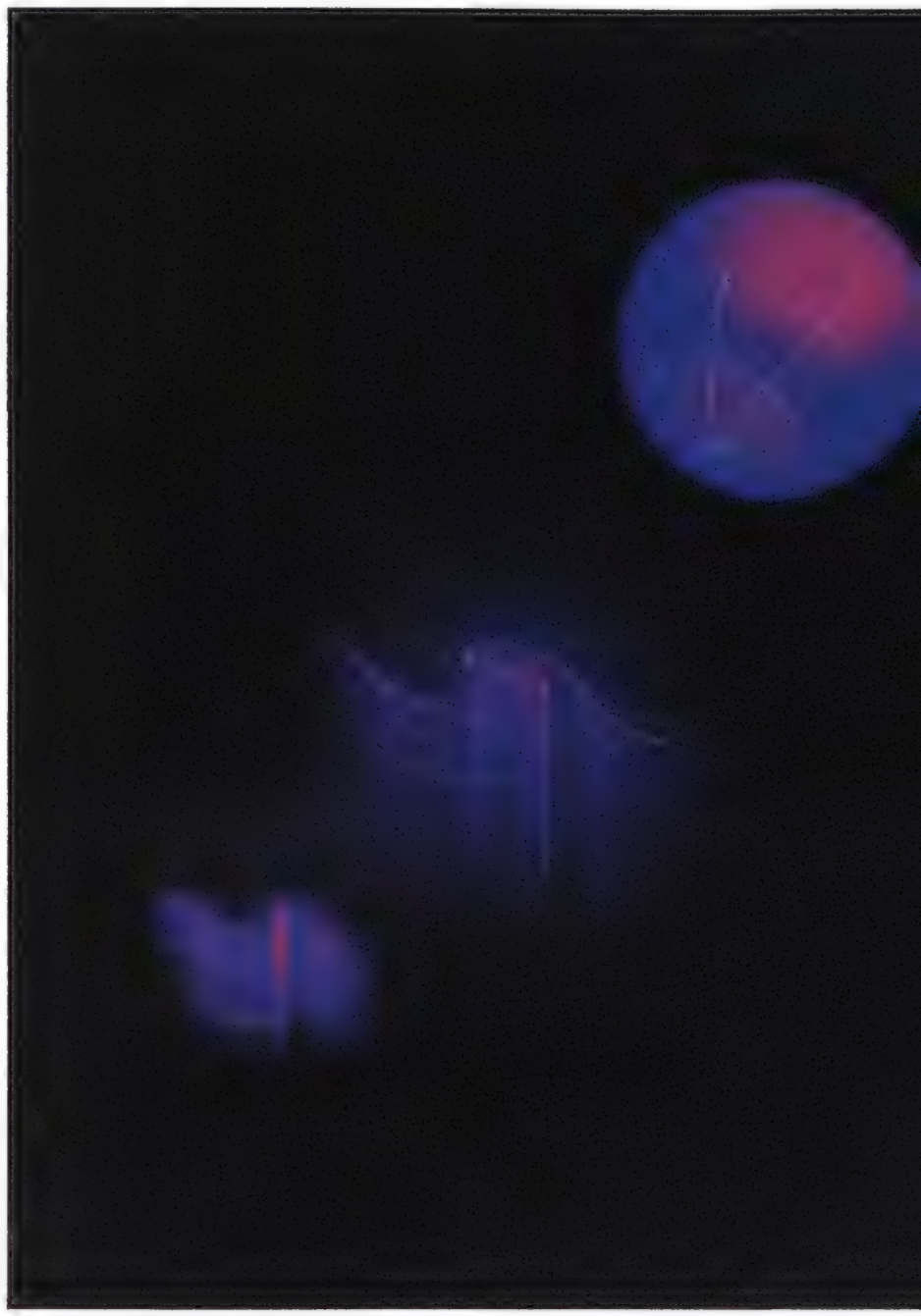
In anything as chaotic as the Big Bang, however, there may be monopoles and quarks which, quite by chance, did not disappear. At the present time, such relic particles would be wandering the Universe like so many Flying Dutchmen. If either kind of particle could be found, we would have more direct evidence for our Big Bang scenario.

Two candidates from the same lab

As you might imagine, both quarks and monopoles have been the subjects of intensive searches. In each case, there is something distinctive about the particle which would make it easy to recognize in the laboratory. The monopole, of course, has an isolated magnetic pole seen nowhere else in nature, while the quarks are supposed to have electrical charges equal to one-third and two-thirds of that on the electron and proton. Surprisingly, the best candidates for successful searches for these particles come from unrelated projects undertaken by the same group at the same institution: the low-temperature laboratory at Stanford University, under the direction of William Fairbank.

Fairbank's quark search actually involves a modern version of the early 20th-century experiment which was used to measure the charge on the electron. A niobium ball about one millimeter across is placed inside a cavity which has been cooled to a very low temperature. Using magnetic fields and some special properties of niobium, the ball is balanced so that it floats in space. The charge on the ball can then be determined by noting the way that it responds to an independently applied electrical force. In 1969, a niobium ball with a one-third charge was found, indicating that there might be a quark on it somewhere. Not content that the result was established beyond question, however, Fairbank refused to publish it and spent most of the next decade rebuilding and improving the apparatus. In 1977, the experiment was repeated with the same result. To date, the group has found dozens of fractionally-charged objects, and no fatal criticism of the technique has been discovered. The general mood of the scientific community, however, is that this result will remain a "candidate" for the discovery of a quark until one of the many other groups now doing similar experiments around the world can duplicate it.

The monopole event happened more recently, at 1:45 P.M. on Valentine's Day in 1982, to be exact. Blas Cabrera had been conducting experiments involving very low temperatures and very low magnetic fields.



"Twists" in space itself, which formed at boundaries of regions where fundamental forces were unified, may have become such exotics as magnetic monopoles.

One of the instruments used to establish that the experiments were, indeed, being conducted in low magnetic fields was a small loop of wire about two inches across. Cabrera realized that if a monopole happened to pass through this small loop, a characteristic and easily recognizable signal would result.

On a quiet Sunday afternoon, with no one in the lab to see, the signal appeared. A monopole, wandering the Universe since the first instant of the Big Bang, apparently went through the loop. An hour and a half later, Cabrera came into the lab and looked at the chart recorder. His first thought, on seeing what may be one of the most important scientific discoveries of the century, was: "What went wrong?"

He started a laborious check of the apparatus, including a series of tests in which he deliberately rapped the delicate equipment to establish that the event was not due to someone coming into the lab to borrow something and bumping into the system.

Cabrera's insistence on being much more critical and skeptical of his experiment than other physicists has led a number of those in the "monopole game" (the author included) to believe that there is a reasonable probability that he has, in fact, seen a relic of the Big Bang. Cabrera has designed an improved version of his experiment. Last fall the new apparatus started to take data, but as of late March it had not recorded a second event.

The picture which our 20th-century creation epic gives us of the beginning of the Universe, then, is a remarkably orderly and simple one. The evolution that led to the present state of affairs proceeded in a series of stages, not all that different from the seven stages of Man that Shakespeare wrote about. Each stage is characterized either by the presence of a different form of matter or by the number of different fundamental forces governing the behavior of that matter.

Our own age, for example, can be thought of as the period when atoms exist and in which the four fundamental forces are all distinct. We can trace this development back to within a hundredth of a millisecond after the Big Bang, using theories which have been directly and exhaustively verified in Earthly laboratories: the ages of atoms, nuclei and elementary particles are no strangers to us. Not far beyond this point our technical capability fails, and we must use the newly minted unification theories to guide us.

Some aspects of these theories, like the unification of the weak and electrical forces, have been subjected to enough experimental tests so that we can have some confidence in their accuracy. The theory which describes the freezing of the strong force at 10^{-35} second after the Big Bang, on the other hand, is much less solid, with the important experiments needed to verify its predictions going on as you read this. Our theoretical guidelines fail us completely at about 10^{-43} second, where the theories which tell us how gravity unifies with the other fundamental forces are still being worked out. Nevertheless, given the progress that has been made in a few short years, it is not overly optimistic to think that even this last frontier of knowledge may someday be pushed back all the way to Time Zero itself.

Back to a state of infinite density

What will we find there? The question is fascinating, although some would maintain that it is not answerable by the methods of science. If we extrapolate back to Time Zero in the simplest way, ignoring the barrier at 10^{-43} second, we will encounter a state of infinite density, a situation which mathematicians call a singularity. If we do achieve a completely unified theory and if it does lead us inexorably back to a singularity, we may never be able to go any farther.

Some physicists do speculate, nonetheless, about applying the laws we know to the very creation of nature itself. Perhaps, the thinking goes, the Universe was actually in an unstable state when it had no matter at all (SMITHSONIAN, December 1981), and the appearance of matter was simply the first freezing in the series that has already been described.

I hope this is how things turn out. We have learned that the Universe is constructed in such a way as to make it possible for us to take the laws that we discover here and now and use them to give us a picture of the Universe back to within 10^{-43} second of creation. The picture shows a Universe becoming increasingly simple and beautiful as we move back in time. How much more beautiful it would be if those same laws could be used to get us not only back to the moment of creation itself, but before.

The countdown from Time Zero

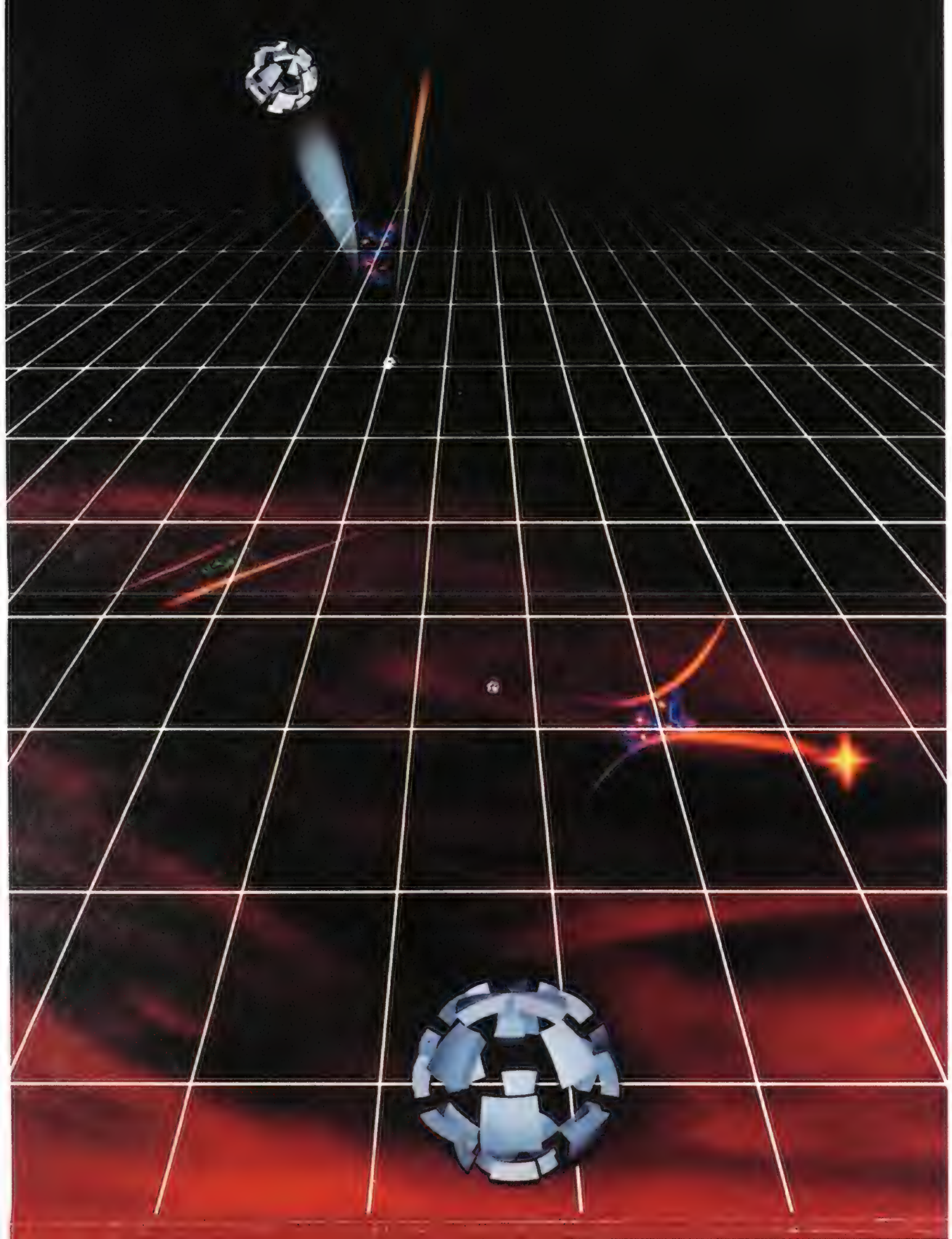
Freeze frames capture rites of passage in the unfolding of the Universe we know today

The Universe started as an unimaginably dense concentration of matter about 15 billion years ago. Little is known about the actual beginning, but we do believe that a titanic "explosion"—an expansion of space itself—started the Universe on its path to the present. The pictures here and on the following pages track the story in a sequence of eight panels, starting at the beginning with the "Big Bang." The action takes place on a receding grid that suggests the passage of time between events.

In this panel, the Big Bang appears as an expansion of the grid from a single point. The duration of this panel is only to 10^{-43} second: a decimal point followed by 42 zeros and a 1. (The time of each panel is shown in the digital readout.) Scientists speculate that during this period the Universe was as simple as it could possibly be. In the present era many different kinds of particles make up the matter around us, and four different forces affect the behavior of that matter: gravity and electromagnetism plus the strong force (which holds nuclei together) and the weak force (which governs some radioactive decay). In the first fraction of a second after the Big Bang, however, there is only one unified force and all particles are fundamentally similar (the primal force and particles are suggested by the illuminated sphere).

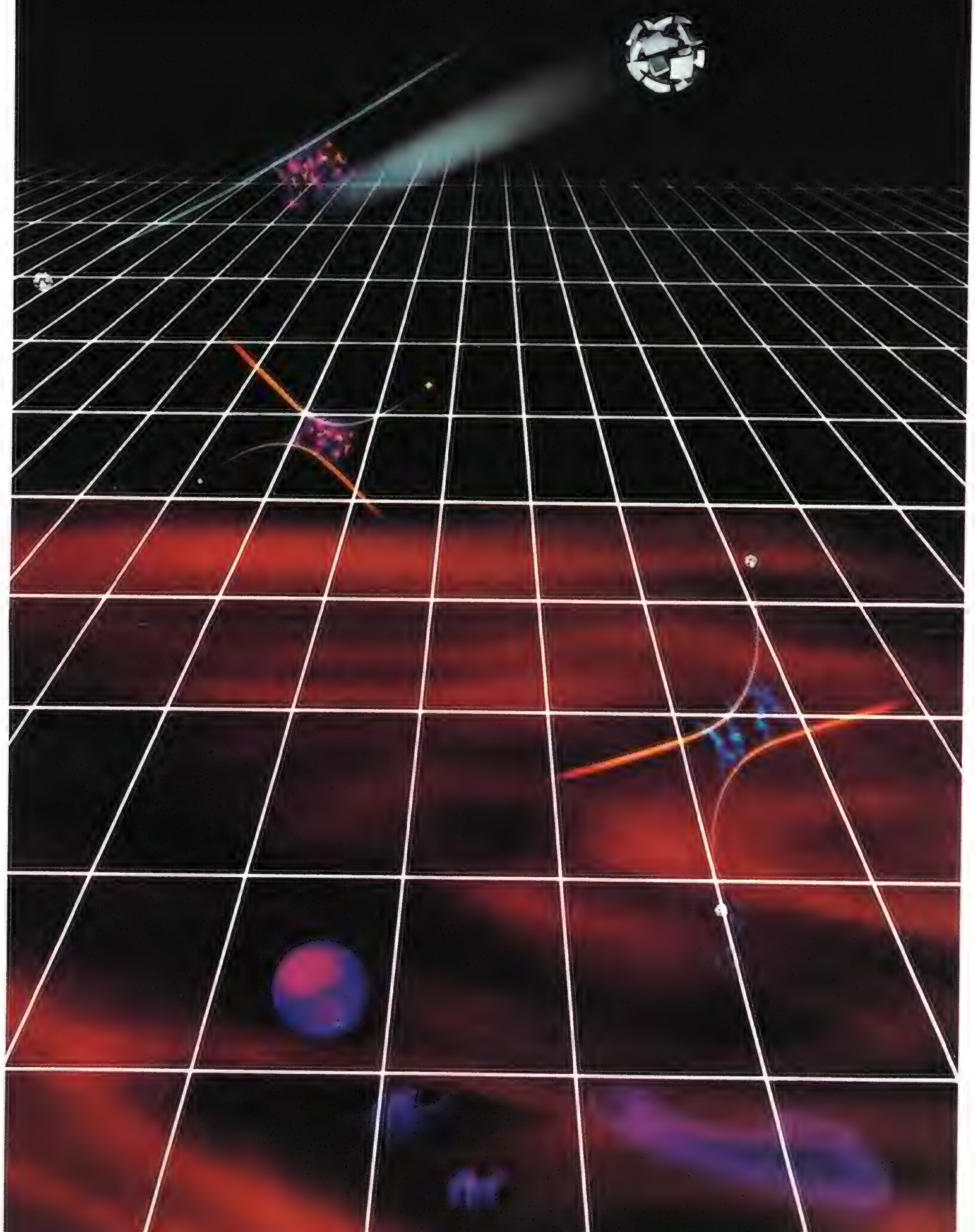
The entire history of the Universe since the Big Bang can be thought of as an expansion during which the Universe cooled off, leading to various kinds of "freezings" whose effect was to produce the diversity of matter and forces we see today. These freezings are traced out in subsequent panels, each of which describes a milestone in the development of the Universe.

Fold out ⟶



Between 10^{-43} to 10^{-35} second after the Big Bang—a time span too small to imagine—the Universe is still very hot (red clouds represent the sea of hot radiation). Particles still exert on each other an undifferentiated strong-weak-electromagnetic force represented by the clusters of magenta, blue and yellow sparks at top and at right center. The Universe has cooled enough, however, for gravity to become a distinct force. Gravity appears here as the greenish sparks acting between the "tails" of the two particles passing each other at left center.

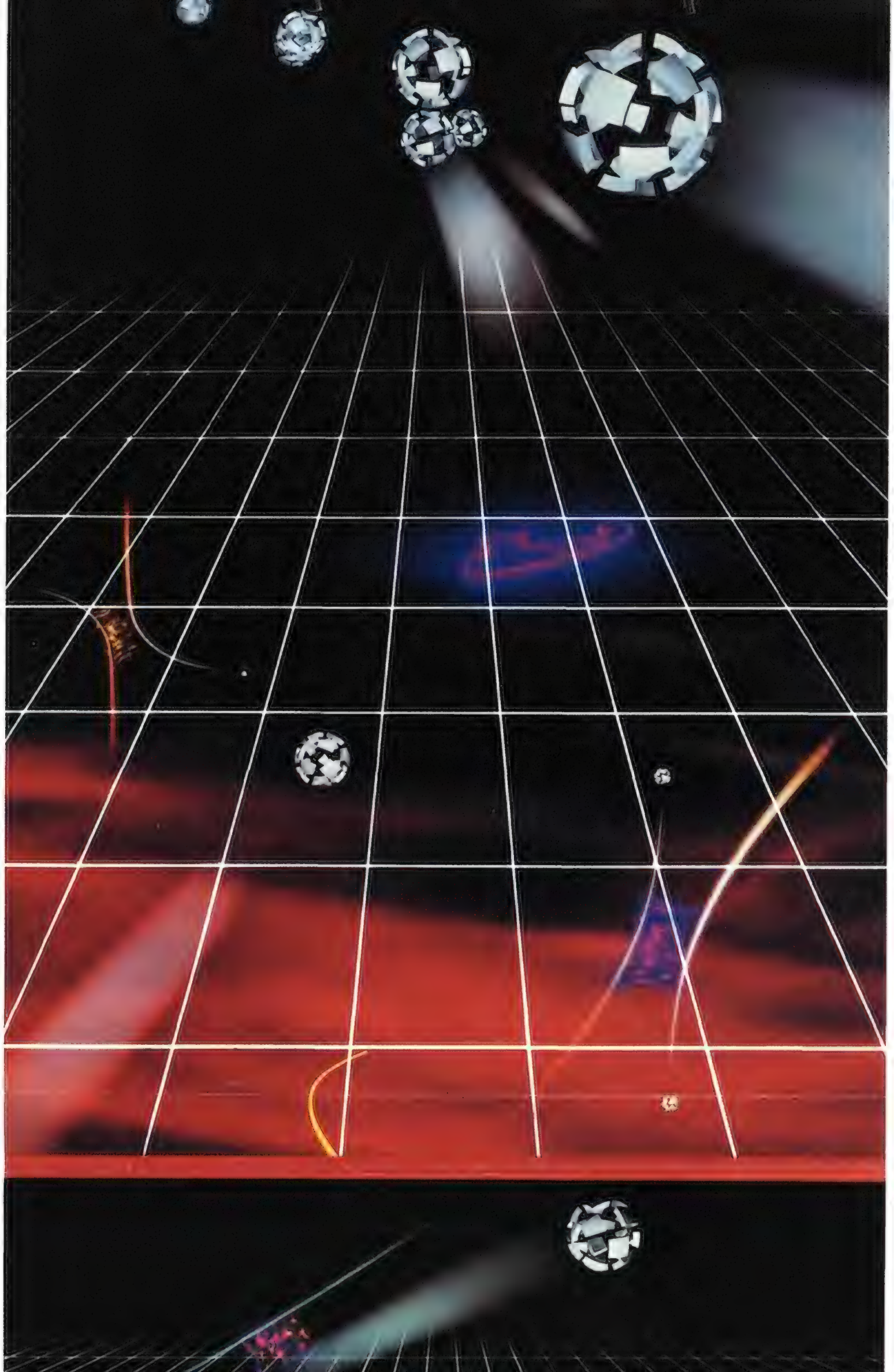
Distinct particles are illustrated here. The electron (represented by a bright yellow cross) exists in atoms today and moves through electrical wires in your home. The quarks (shown as fragmented spheres) will combine later to form protons and neutrons. During this period quarks and electrons can still convert into each other. This moment in time marks the research frontier in physics today.



10^{-10} SEC

We now enter a period in which the continued cooling of the Universe has resulted in still more differentiation. The strong force now exists by itself; here it operates (bluish sparks) between the two quarks at right center. The electromagnetic and weak forces are still combined, interacting between two quarks passing each other at top and a quark and an electron, which are no longer interchangeable. Early in this era magnetic monopoles (globe in foreground) may have formed between regions of space at diverse stages of differentiation. Another postulated structure of this period is a stringlike concentration of mass, shown as a loop in the right foreground, around which a future galaxy could possibly condense.

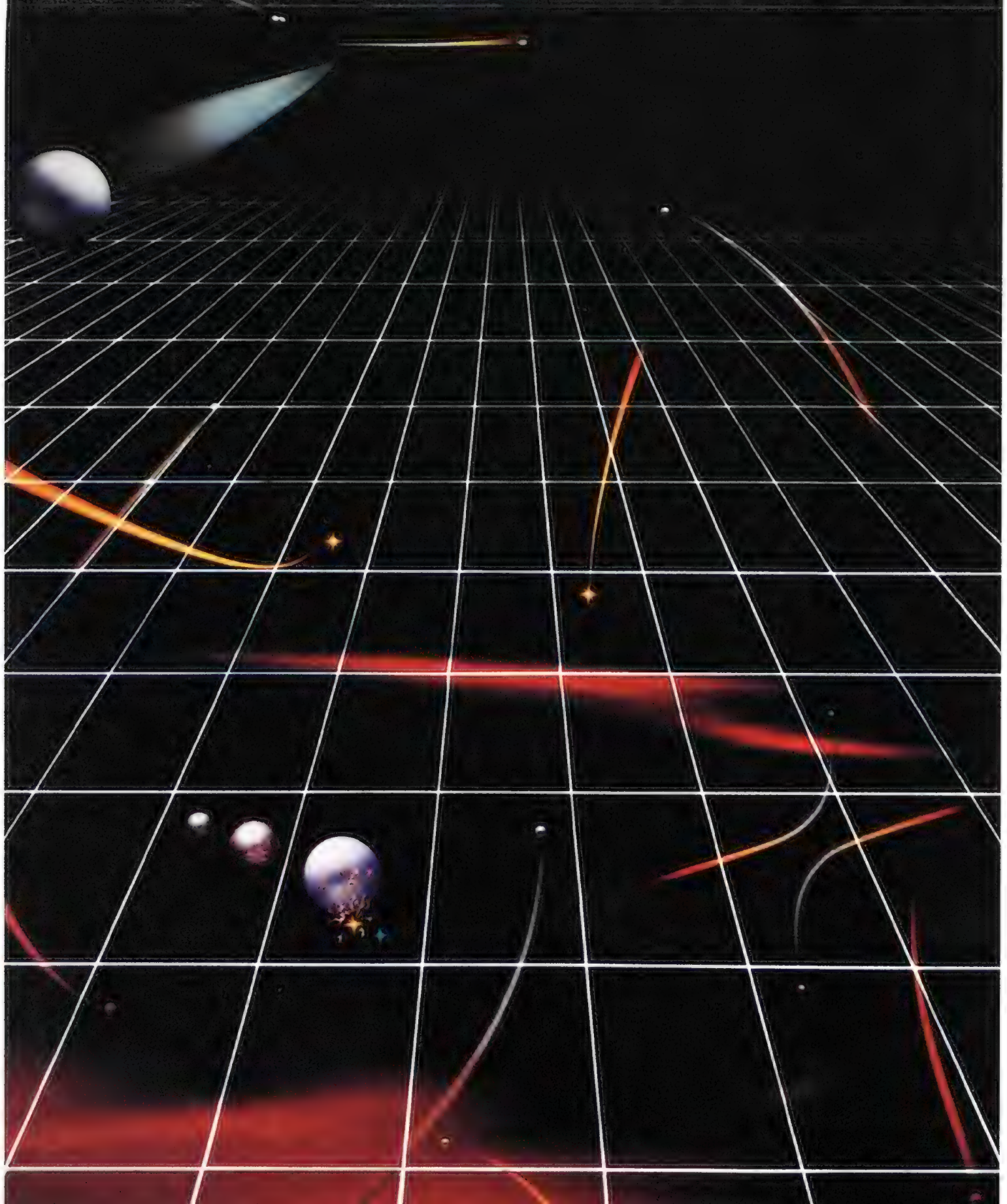
10^{-35} SEC



10^{-5} SEC

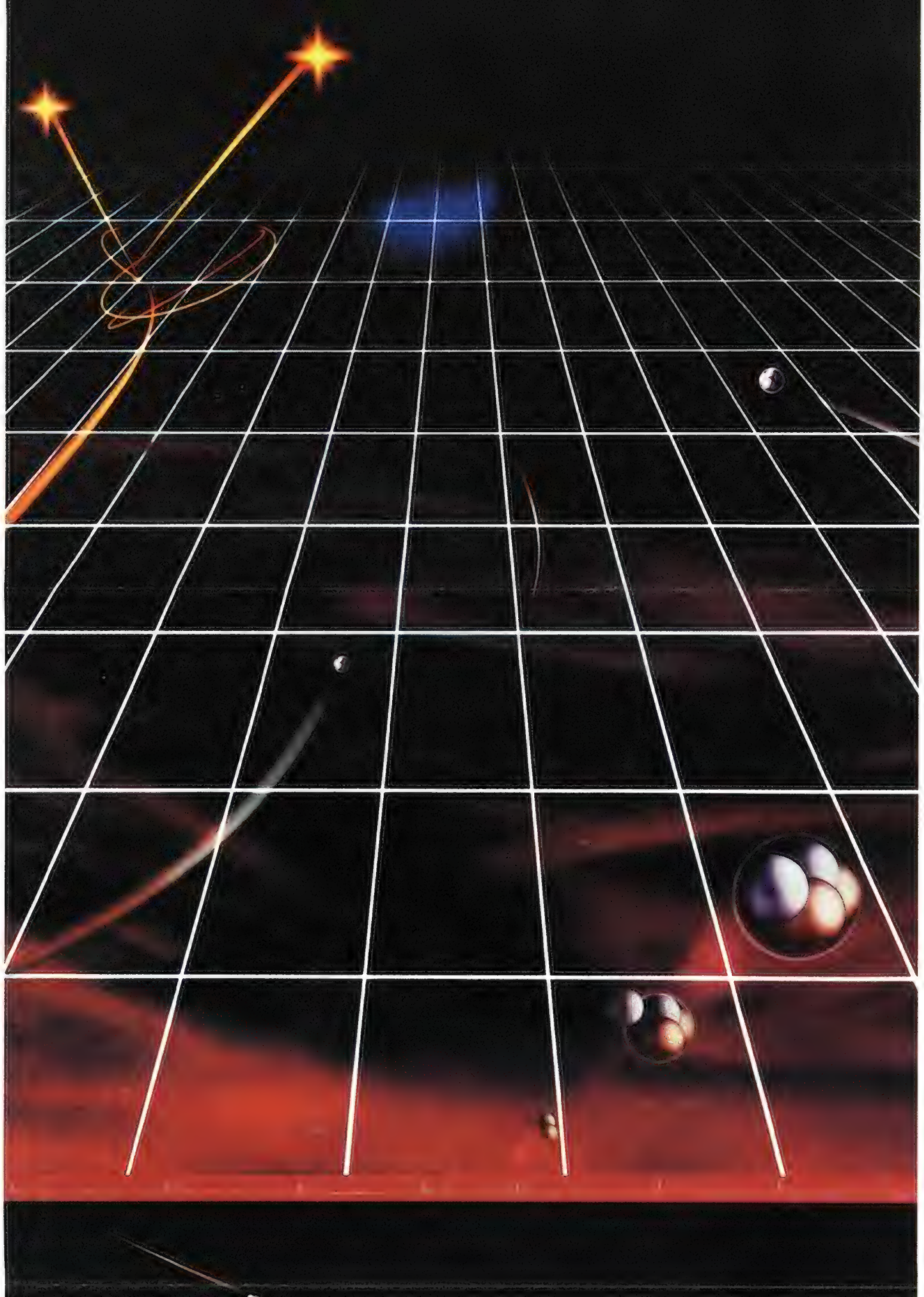
This panel presents the Universe from its first ten-billionth of a second down to the first hundred-thousandth or so. The radiation continues to cool, and now the combined electromagnetic-weak force has become two distinct entities. In the right foreground, two quarks are acting on each other through the electromagnetic force alone (magenta sparks) while at left center two other quarks affect each other's motion through the weak force (yellow sparks). Near the end of this era, probably when the Universe is a hundredth-of-a-millisecond old, quarks begin to come together (top) to form protons, neutrons and other particles.

10^{-10} SEC



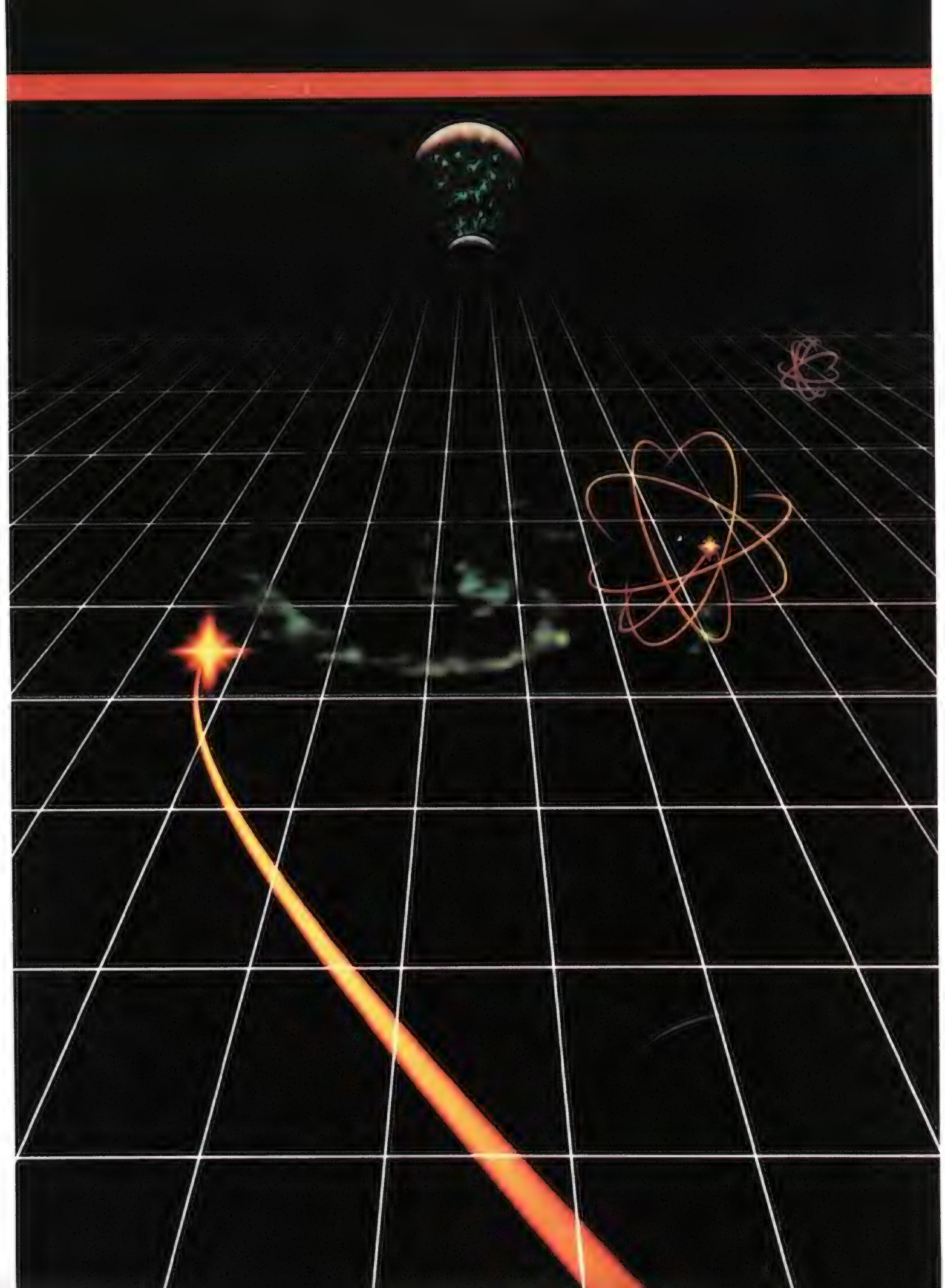
3 MIN

Starting at around a hundredth-of-a-millisecond, the Universe begins to look familiar. All the particles we now know are present; quarks have combined to form protons and neutrons (spheres), although the Universe is still too hot to allow them to come together to form atomic nuclei. Any such nucleus that does manage to form is immediately broken up by collisions, as has happened at upper left. Other particles in this picture are doing things they still do today: in the sequence below and left of center, for example, a neutron (smallest sphere) decays into a proton, an electron (yellow cross) and a massless antineutrino (blue). Note the yellow flickering of the weak force involved in this radioactivity. Electrons and other particles swoop through space.



500,000 YRS

By about three minutes after the Big Bang, the Universe has cooled off enough so that protons and neutrons can come together to form the nuclei of atoms, at lower right. The temperature is still too high, however, for atoms to form. If an electron should go into orbit around a nucleus to create an atom, it is knocked away by collisions, as is happening to two electrons at upper left. The mass concentration, perhaps the seed of a galaxy in the distant future, is still present as a bluish loop on the far horizon.



RECENT PAST

About 500,000 years after the Big Bang, the temperature has dropped enough to allow atoms to form (upper right). Until now the radiation exerted enough pressure on particles to prevent them from clumping into large concentrations like galaxies and stars. Once atoms form, however, matter becomes transparent to this radiation and the process of collection and condensation can begin. Mass concentrations, now shown as the S-shape at center, might form the nuclei for galaxies, much as motes of dust can serve as nuclei for the formation of raindrops. In the distance, farther along in time, two planetary bodies have formed, interacting with each other through the familiar force of gravity.

500,000 YRS

Fold out

TODAY

All of which brings us to the present, in which a star illuminates a ringed planet, a gas giant at top, and a space telescope. (The view is from a spacecraft above the atmosphere of an imaginary planet.) Physicists today are trying to expand our knowledge of the early Universe on two fronts: theory and experiment. Many theorists are working out the details of the grand unification theories which describe the Universe between 10^{-43} and 10^{-35} second. Others are trying to develop theories that would describe events represented in the first panel (from Time Zero to 10^{-43} second). Some even speculate about the moment of creation itself. On the experimental front, physicists are searching for particles created early in the evolution of the Universe, and serious debate goes on as to whether magnetic monopoles and quarks have actually been detected in the laboratory. Others are testing predictions of the grand unified theories by searching for physical phenomena occurring today.

Physicists play the waiting game

Any experiment that is to have a chance of seeing the rare decay of a proton requires two things: lots of protons to watch and a way of excluding things that could masquerade as genuine decays. The first requirement is easy to meet, at least in principle. Experimenters must simply gather large amounts of materials and install instruments which would detect a decay if it occurred. The second requirement is not so simple. To shield the experiment from cosmic rays (particles from space continually raining down on Earth), the experiment must be located deep underground.

The statement that a proton-decay experiment has to be in such a location is a little like the well-known recipe for bear stew that begins: "First, get a bear." Old mines tend to deteriorate rapidly, and renovating them can be expensive. Even locating a suitable mine can present unforeseen difficulties, as I discovered when I talked with Marvin Marshak of the University of Minnesota (the principal investigator of the first proton-decay experiment to take data in America). "We went to one place," says Marshak, "where there was a big office with phones and typewriters and papers on the desks, but no people. We asked around in a nearby bar and found out that they hired local people to sit at the desks whenever a potential financial backer came through. Believe me, we got out of that deal just as fast as we could."

The largest proton-decay experiment, run by a team from the University of California at Irvine, the University of Michigan and Brookhaven National Laboratory, had better luck. They found that Morton Salt, a division of Morton-Thiokol, Inc., had a history of providing underground experimental space to physicists. A new cavern was excavated in a mine near Lake Erie, and the physicists were even able to give the salt back to Morton to lower their construction costs. A plastic-lined tank was installed about half a mile underground to hold 8,000 tons of water. This much water contains considerably more than 10^{33} protons. The tank was fitted with arrays of phototubes which could detect the radiation given off by a decay product as it zipped through the water, if and when a proton actually did disintegrate in a certain way.

So large is this apparatus, and so important is the requirement that the instruments be able to see events taking place in distant parts of the detector, that the tank has been fitted with an extensive filtering system, making these 8,000 tons exceptionally pure. Lawrence R. Sulak of the University of Michigan, one of the principal investigators in this experiment, notes that the water is so clear that "when you stand on the catwalk and look down through 65 feet of it to the apparatus at the bottom of the tank, you can barely tell that the water is there."

Last August, after extensive testing of the electronic systems, the tank was filled with water and the long watch began. No proton decays were seen in the first 80-day run, a result that was announced in January. The experiment continues, of course, and Sulak estimates that it will take at least three years to exploit the full sensitivity of the apparatus. If nothing is seen in that time, the conclusion will be that the proton lifetime is longer than originally anticipated.

Whether the decay is seen or not, however, the results of this experiment and others will play an important role in the future development of our ideas about the birth of the Universe. "After all," says Sulak, "it's the only way that we have to observe directly primordial forces which have not been apparent since a fraction of a second after the Big Bang."

James Trefil

In 65-foot tank inside mine, diver inspects phototubes that will record proton-decay debris in effort by team from California (Irvine), Michigan, Brookhaven Lab.

Next month: How the Universe will end

By John Canaday

English landscape still lives on in Constable country

More effectively than anyone else, this artist revealed the beauty of the gentle green land that existed before the Industrial Revolution

By the time he died 146 years ago at the age of 60, the English painter John Constable had created (a word that will have to be examined later) a land of fields, meadows, lawns, heaths, streams, glades, copses and eventful skies that was already being called Constable country by his compatriots. Today, Constable epitomizes the charm of England's countryside as visitors expect to find it—pastoral, verdant, unblemished by such subsequent evils as the grime of the Industrial Revolution, the highway scars of the automobile age and the various disfigurements of urbanization. Find it they will in the exhibition "Constable's England" at the Metropolitan Museum of Art through September 4; this is part of the "Britain Salutes New York 1983" festival.

Passing by coach through the valley near Dedham, Constable once remarked on its beauty to a fellow passenger, a stranger, who replied, "Yes, Sir, this is Constable's country." Relating the incident in a letter to a friend, the engraver David Lucas, Constable added that "I then told him who I was, lest he should spoil it." What the stranger answered we don't know, but since Constable was in his 57th year at that time, at the height of his prominence, with a record eight paintings in that year's Royal Academy exhibition, it is pleasant to think that his companion in the coach might have said something like, "Why, damn it, Sir, what a damn fine painter you are! You have made Dedham Vale famous throughout all England and taught us the beauty of our own country!"

Museum of Fine Arts, Boston

Constable's *The Stour Valley and Dedham Village* was a majestic evocation of the pastoral countryside.

Victoria and Albert Museum, London

Detail of a full-scale oil study of *The Hay Wain* (opposite) shows artist's fluent, powerful brushwork.

That was in 1832. If in 1983 the landscape seems hardly changed, it is because Constable captured its essence so vividly that no one familiar with his painting can fail to perceive the England they are looking for beneath whatever overlay has accumulated, an England that Constable revealed.

"Revealed," not "created," is the word here, and even "revealed" might have been questioned by Constable, who held that truth to nature as it faces him must imperatively be the landscape painter's first loyalty. If the idea is not startling today, it was esthetic heresy at the time. Constable painted against the current of an academic tradition by which landscapes were synthesized in the studio from bits and pieces of nature as it was idealized, imagined, invented and even codified in handbooks for convenience. In France the synthesis was devoted primarily to visions of classical antiquity set in never-never terrain (which might be of great beauty) organized on the principles of classical harmony. In Germany, visionary landscapes—Caspar David Friedrich's in particular—served as both settings and symbols for moody philosophical reflections on life, death, the soul and mystical Christianity.

Constable would not have approved. Such philosophical extensions as are pertinent to the art of landscape painting, he felt, are inherent in the natural countryside, and any further ponderings could be left to his literary contemporaries, Wordsworth and the other Romantic nature poets. As for synthesizing landscapes on classical models, no such artifice could match the interrelationships between earth, water, trees and sky determined by natural forces. "Natural," in its primary definition, of or arising from nature, is the key recurrent term in what Constable wrote and is reported to have said about the basic principles of his art. The way to truth to nature lay not only in direct reference to specific scenes and vistas, and not only those places in specific seasons and weathers, but even to specific times of day.

Painting as another word for feeling

Constable recognized, however, that strict adherence to externals was only half the whole truth. In 1821, answering a letter from his most intimate friend, John Fisher, who had described rhapsodically the sights and sounds of a stream, its banks and an old mill, Constable wrote "As long as I do paint I shall never cease to paint such Places. . . . Still I should paint my own places best . . . ." and then added as important a principle as any he declared in his hundreds of letters, a principle that demolishes any implication that truth to nature must be objective. "Painting," he wrote, "is . . . but another word for feeling," and it is his expression of this feeling, his emotional response to nature,

National Gallery, London

The Hay Wain, 1821, was one of a series of large canvases painted for Royal Academy exhibitions.

especially "my own places," that raises Constable's landscapes from the merely topographical to the revelatory. There is no way of knowing what Dedham Vale had looked like to Constable's fellow passenger in that coach before he saw Constable's paintings, but it is safe to assume that his vision of it had been enriched by proxy experience of Constable's own responses.

Constable's most idyllic paintings were inspired by memories of his boyhood on the banks of the Stour, and their halcyon mood makes them the most popular of all his work for the widest public. In *The Cornfield* (p. 57), painted in 1826 when he was 50, a boy lies on his stomach on the bank of a stream to take a drink of water, and the figure is presumptively identified as Constable's memory of himself when he used to take the nearby path on his way to school. Perhaps so, yet when "painting is another word for feeling," this bit of sentimental genre can be intrusive, at least for the most ardent Constable lovers, who enjoy Constable country most when they can have it to themselves. Constable is rarely guilty of the kind of storytelling where the observer's sympathy is courted by stirring up familiar—even trite—associations with a subject like the drinking boy; his paintings affect us most deeply when the emotive factors are more subtle. He confessed to John Fisher that in the hope of finding a purchaser he had given the picture "a little more Eye-salve than I usually condescend to give . . . ," and it seems obvious enough that this salve included the figure of the boy, with its surefire sentimental appeal.

Discounting the salve, *The Cornfield*, along with the even more famous *The Hay Wain* (above), exemplifies Constable's most formal, most studied manner, the kind that, in pictures of large size like these two, declared itself as a painters' manifesto in the make-or-break official exhibitions of the Royal Academy. The persistent feeling in 19th-century academies that pure landscape was a secondary art form may explain why Constable introduced human figures (at which he was, in truth, none too skillful) into so many paintings that could have done just as well without them.

Eminent critic and writer on art, John Canaday last wrote on Paul Mellon in the April 1983 issue.

National Portrait Gallery, London

Constable at age 23, as painted by Ramsay Richard Reinagle, a fellow student at the Royal Academy.

With the drinking boy as an exception, these beings are usually rustics going about their daily tasks, integral parts of the life and growth of the natural scene rather than intruders. As an unquestioning member of the entrenched upper middle class in the rigidly stratified English society of his day, Constable saw these rustics not as nature's noblemen, not as monumental symbols (as Millet was soon to make them), certainly not as members of a class brutalized by toil and subservience, and not even as picturesque supernumeraries in bucolic settings. He saw them, at least by the evidence of his paintings, simply as natural phenomena, hardly more sentient and even less individualized than the trees, waters and skies around them. As far as the unity and harmony of his landscapes are concerned, that is exactly as it should be.

Constable is one of those painters whose brush seems to have responded with a perception of its own in accord with the artist's mood. There is a great deal of variety in his attack, from rapid on-the-spot sketches that seem electrified with eagerness to capture the essence of a scene or object instantaneously (it is surprising to hear him refer to some of these as "laborious" notations) to the carefully calculated spotting of colors in the construction of exhibition pieces like *The Cornfield* and *The Hay Wain*. The character of Constable's brushstroke is at least as important as the nature of his subjects in establishing the happy mood of his paintings during the years of search and fulfillment, his happy years, and becomes even more important later on when the same motifs are reinterpreted in stormy scenes described in slashing brushwork evoking sensations of threat, apprehension and unrest in his years of despondency following the death of his wife, Maria.

Doubt in the midst of success

Constable—whose personality is not an easy one to reconstruct in spite of his masses of correspondence and the detailed reports of his contemporaries—suffered from undercurrents of insecurity that were, indeed, understandable during his early years of struggle for recognition and his consequent precarious financial circumstances. But by the time Maria died he had become both famous and, if not rich, without serious money problems, yet from year to year for the rest of his life he became more withdrawn, pessimistic, morose and racked with doubts as to his achievement —while producing some of his finest work.

His marriage, by most of the evidence, had been one of true devotion forced along a difficult course from beginning to end. Constable was 33, a handsome man in his prime, when he fell in love (or decided he was in love) with Maria Bicknell; she was 21. Her grandfather, Dr. Rhudde, rector of East Bergholt, opposed the marriage with almost pathological stubbornness, and Maria's parents weakly followed along. Dr. Rhudde objected primarily to the unpromising future of a painter—and a mere landscape painter at that—who, with middle age in the offing, had yet to make a reputation; he seized on more trivial objections as well, managing to extend the engagement over six of the brief years Constable and Maria were to have together. After this long delay, Constable began to have misgivings of his own about the conflict between art and marriage, which he relayed to Maria in a letter not quite breaking the engagement but virtually inviting her to do so. Maria, on the verge of spinsterhood by the standards of the day, responded with bitter objections to further postponement, and Constable succumbed. Married at 28, Maria (a lovely creature in Constable's portraits of her) died at 40 of consumption, having borne seven children after difficult pregnancies and at least one miscarriage during a period of ten years of increasing invalidism.

Constable's letters show that he was a doting father, frequently taking the children on vacations. The seven children remain rather vague figures except for the eldest, John, a moody youth who shared his father's love of nature and was so distressed by his

father's death (in 1837, when young John was 20) that he could not attend the funeral. Thereafter John entered Cambridge to read theology, but died of scarlet fever in 1841, a disease that had already claimed Constable's daughter Emily in 1839 at the age of 14. In 1853 another son, Alfred, drowned in the Thames. One son, Charles, said to have been of a rather dreamy temperament, became a sailor in his early teens, which took him to India and China. The eldest daughter and second child, named for Maria but called Minna, 17 when Constable died, did her best as head of the small orphanage he left behind.

Constable's letters are so full of contradictions that even his most sympathetic biographers suspect that here and there he fabricated for effect. But with all the confusion, two developments in Constable's personality run consistent courses. His early failures to gain full recognition in the Royal Academy, in spite of his efforts to play the necessary political games, led naturally enough to feelings of frustration. These turned to resentment and hypersensitivity to criticism even when, at last—a few weeks after Maria's death—he was elected Royal Academician.

And while he became progressively more daring, more liberated, more heretical, in his approach to painting, with the downright modernism (in 20th-century terms) of his late work, he became regressively hidebound in his sociopolitical convictions, an extreme Tory who reviled the nascent humanitarianism of labor and agrarian reform movements, which would "give the government into the hands of the rabble and dregs of the people, and the devil's agents on earth, the agitators." But neither his resentment nor hyperconservatism affected his allegiance to nature, which remained for him the source of all good.

In spite of their troubles, the years of his marriage to Maria were the best years of Constable's life, including the climactic one, 1824, when *The Hay Wain* created an international sensation in the Paris Salon, brought Constable a gold medal from the French government and, amazingly, produced the paradox of an English painting as a landmark in the history of French art.

The Hay Wain became famous half by chance. A Paris art dealer, thoroughly French but contradictorily named John Arrowsmith, who remains a shadowy figure historically and was, perhaps, a shady dealer as well, bought the picture in expectation of exhibiting it in the Salon and selling it to the French national collections. John Fisher urged Constable to sell at Arrowsmith's price since a success in France would raise the "stupid English public's" esteem for a native son. Accepted, *The Hay Wain* was seen before the Salon opening by the young Romantic rebel, Delacroix, who was so bowled over by its colorism that he repainted portions of his own Salon entry. But where

Yale Center for British Art

Constable made precise, annotated studies of clouds, as in *Stratocumulus Cloud,* dated September 28, 1821.

National Gallery, London

The Cornfield did not sell until after artist's death. It was bought for National Gallery.

The Hay Wain was a sensation, Delacroix's *Massacre at Chios* was a scandal. Apparently it was all right for an Englishman to paint by juxtaposing spots of color rather than blending them, and to retain the feel of the brush on the surface of the canvas, but it was impertinent of a young Frenchman to violate the standards of Salon technique with roughly textured passages and areas of broken color in a painting that, when accepted by the Salon jury, had satisfied the academic formula of slick surface and carefully blended gradations of tone. His discovery of Constable initiated Delacroix's experiments in colorism that occupied him for the rest of his life and made him, as an aging man, the idol of the young Impressionists, who consummated the technical devices that Delacroix had adapted from Constable.

Constable's chosen ancestors in turn had included, from 17th-century Europe, the luminous inventions of Claude Lorrain and the stormiest of Jacob van Ruisdael's concocted scenes. But he was proudest of his 18th-century English ancestors, Richard Wilson and the great Thomas Gainsborough, and resentful that the tradition of English landscape painting that they initiated was so little appreciated in Europe or, for that matter, at home. Wilson, as Constable was to do, rejected synthesizing and painted specific spots in the English countryside, although modified in the direction of classical disciplines. As for Gainsborough, Constable said as a student, "I fancy I see Gainsborough in every hedge and hollow tree." But he stopped short of imitating the painter he most admired.

No other landscapist has exceeded Constable, if any has equaled him, in expressing the dynamic interaction of all the elements of nature fusing into an indivisible whole. His skies are never simple blue backdrops, not even backdrops spotted with white patches of clouds. His skies reach out over and into the land and what is grown and built on it, all-embracing. As we enter his landscapes the clouds, rather than floating in the distance, unite the sky over our heads with the earth under our feet, the bushes and trees at our side, the vistas beyond and behind us.

Constable is sometimes called a pantheist, but Constable country is not really infused with any divine presence. Nature by itself, just as it is, is wonderful enough to need no mystical props. Truth to nature is all that is needed in Constable country, and Constable, without worrying over semantic problems as to just what truth is, captured it by painting what he saw in terms of what he felt.

The Art Institute of Chicago

A late-period landscape, *Stoke-by-Nayland*, was painted about 1835, when Constable was nearing 60.

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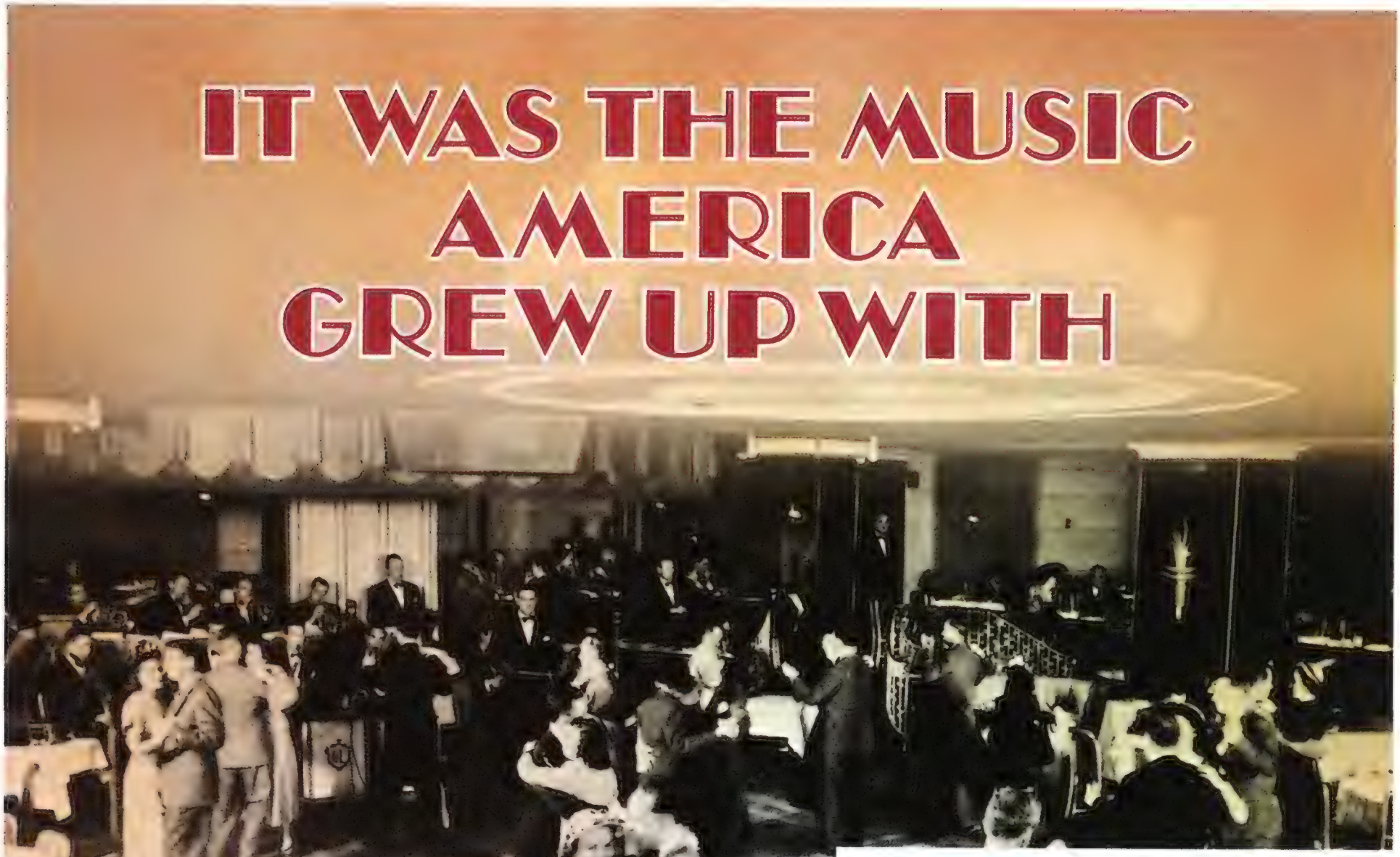

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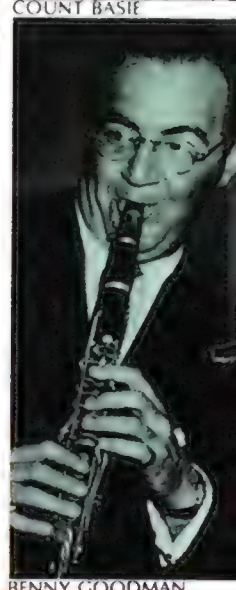
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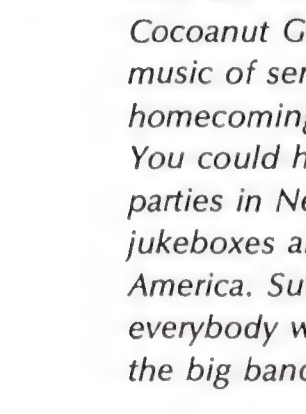
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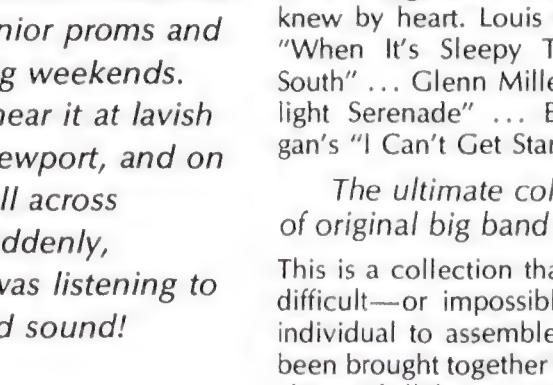
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Vast exhibition of the proper European gear for horses

By Rudolph Chelminski

Making a museum out of a stable as big as the Ritz

In Chantilly, the latest attraction for tourists is the lengthened shadow of a horseman named 'Beloved' and an 18th-century prince

The anecdote dates back to 1782. It happened while Louis-Joseph, eighth Prince of Condé and son of the Duke of Bourbon, was having a few friends over for a bite on the grounds of the family chateau at Chantilly, 25 miles north of Paris.

The Prince and his guests were seated in a vast circular room built of the cream-colored stone that characterizes the Ile de France, lit by hundreds of lanterns reflected prettily in the rippling basin of a marble fountain. Above them, faintly discernible in the penumbra behind an iron railing, liveried musicians tootled baroque airs, while even higher—lost in the shadows—the summit of the building's great dome soared nine stories above the paved stone floor.

"Monseigneur," cried the Condé's *invité d'honneur*, the Grand Duke and future Czar, Paul of Russia, "what a magnificent dining room!"

"But Sire," protested the Condé with the false innocence of those who are deeply immersed in the princely art of one-upmanship, "these are only my stables."

At a clap of his hands, well-rehearsed lackeys drew aside the draperies, suddenly revealing the twin wings

and riders stretches nearly 300 feet under the antlered archways of France's new Musée Vivant du Cheval.

that ran out from the dining hall. The perspective that greeted the guests was stunning: two cathedral naves, joined by the central rotunda in which everyone was seated, and measuring 610 feet from one end to the other. The effect was made even more striking by the apparently anomalous presence of 240 horses, each in its comfortable stall.

"Tomorrow, Sire," the Condé promised, "we shall sup in the chateau."

The vast stables, or Grandes Ecuries, of Chantilly were destined to be something very special from the start. The Condé's father, Louis-Henri, seventh Prince of Condé, had commissioned an architect named Jean Aubert to design him a layout so grand that it would rival Versailles, where his cousin, Louis XV, held court amidst regal ostentation. The prince had no problems with money (he was Louis XV's principal minister). And he knew that even though he could not top Versailles with his own lake-sitting chateau, as lovely as it was, he still had a good chance of becoming Number One in the hunting league by building a stable as big as a palace. In the early 18th century, venery was still the greatest passion of the nobility, and hunting, perforce, meant fine horses and superior horsemanship. Hence the idea for the Grandes Ecuries, grander than anywhere else.

"Everyone hunted," explains Sylvie Binet in *Les Grandes Ecuries de Chantilly*, published this month in France. "The men would spend all day in the saddle, and the women would often join them in specially-designed carriages, from which they could throw darts out at all those unfortunate animals. They had a wonderful time."

Given virtually unlimited funds, Aubert worked for 16 years, between 1719 and 1735, to create the masterpiece of his life, one that is still listed in French guidebooks as an attraction fully equal to the chateau it was intended to serve. It was, in effect, a temple to the horse, as unique today as it was when it was built, and is naturally classified as a national monument.

From prince to prince, the stables sustained their role as the world's center for elegance in hunting and horseflesh until royalty was swept aside by the French Revolution. During the troubled years that followed,

Photographs by Loomis Dean

Museum founder Bienaimé, *à cheval* in front of Les Grandes Ecuries, wears Louis XVth riding habit.

the stables' utilitarian nature spared them some of the vandalism visited upon much of France's aristocratic architecture (including the nearby chateau on the lake). The stables, in fact, served as shelter for Revolutionary gendarmes, and later for Napoleon Bonaparte's cavalry. With the restoration of the monarchy in 1814 hunting returned and the chateau was rebuilt, but things were never quite the same. The House of Condé expired in 1830 and the property passed to the Duke of Aumale, fifth son of King Louis-Philippe. At Aumale's death in 1897, the chateau with its art treasures and famous stables went to the Institut de France.

The Institut has always maintained the chateau itself as an art museum. But government bureaucrats concluded that the Grandes Ecuries were too big and too expensive to staff, as well as being of less artistic merit than the painting-filled chateau. Aubert's building had been closed until after World War II, when it was leased to a private riding club, the Cercle Hippique de Chantilly. Tourists of especial persistence were permitted to visit one wing, one day a week. Gradually, the stables fell into decline: the splendid stonework acquired a patina of dirt, windows were blocked off with plywood.

In 1959, a young riding instructor with the winning name of Yves Bienaimé (Yves, the beloved) signed on with the Cercle Hippique. Fresh out of the army and full of vim, he took up residence in what had been the stablehands' quarters, in an attic above the vaulted nave. At the time no one could guess, not even Bienaimé, that this was to be an historic crossing of destinies. It was, in fact, the beginning of an association of the heart, of a love story even, that developed into the achievement of a lifetime's dream for Bienaimé (left) and the restoration of an architectural chef d'oeuvre in deadly peril.

Bienaimé, a nervous, ambitious and energetic man whose parents had hoped would become a lawyer, was marked in his childhood by the trauma of an apparently incurable lisp. It brought him the taunts of classmates and an abiding loneliness which, in his early teens, his parents tried to palliate by offering him a horse. That was the turning point of Bienaimé's life. During long and solitary rambles round the Picardy countryside where he was born, Bienaimé came to understand and love "'man's noblest conquest," as the French refer to horses, and, in doing so, regained his shattered confidence. He abandoned any inclination toward law, threw himself into speech therapy and, once cured of his lisp, went on to study horsemanship full time. "Everything I have today I owe to horses," he says.

In the snobbish world of French equitation, Bienaimé went from success to success. At 25 he was the youngest Frenchman ever to win a prestigious diploma as "master horseman" (*écuyer professeur*). A year later he struck off on his own, taking faithful clients with him from the Cercle Hippique to start another club in a village near Chantilly. It became so popular that he founded a second, then a third. Within 15 years of his start he was running three of the most prosperous stables in France, though more as administrator than horseman. "I didn't like that at all," he says.

Over the years, an idea slowly germinated within Bienaimé. The Grandes Ecuries could be turned into

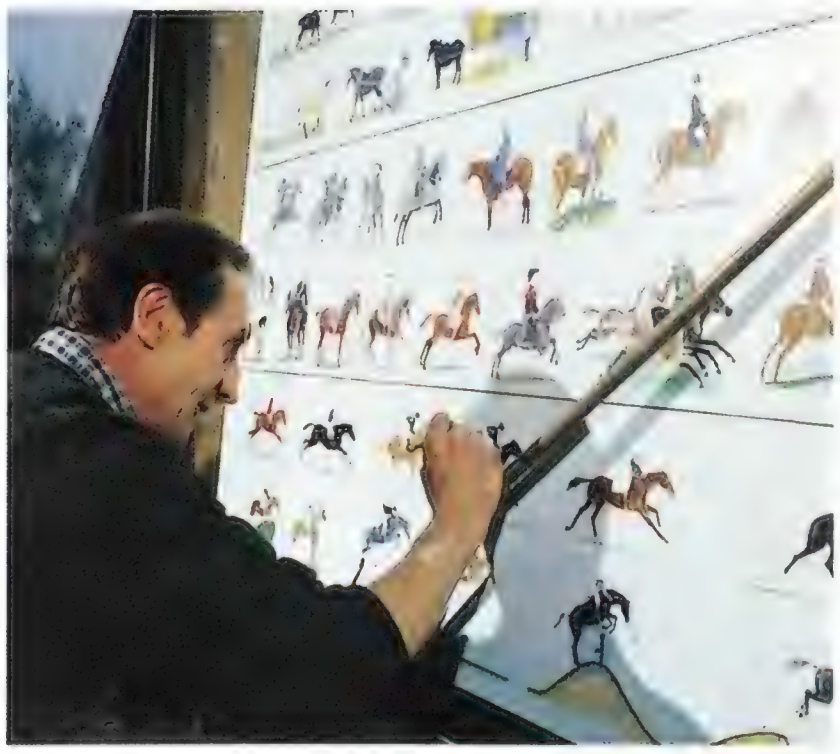
In this replica of 19th-century blacksmith shop, model smith files shoes of full-scale thoroughbred.

a museum, and he was just the horseman to do it. Why not? Nobody else would be fool enough to undertake so vast and risky an enterprise. Certainly not the Institut de France.

"I was always in favor of free enterprise," Bienaimé explains, "and I knew how things work. If the administration tried to make a museum there, they would have to allocate a huge budget and fill the place with functionaries. Right now the chateau has 33 employees, not counting the gardeners, and would have gone broke long ago if it weren't for special donations."

When he first approached the Institut, his reception was the one traditionally reserved in France for new ideas: horrified expressions of disapproval, plus a chorus of reproving ooh-la-las. Slowly and patiently, Bienaimé persisted, and with time the sheer logic of his idea grew more convincing. Everyone had to agree that the stables would be a lovely setting for a horse museum. The town of Chantilly is the world's foremost equestrian center. It has a sporty grass racetrack, and usually about 3,500 thoroughbreds of all nations are being trained there. So a horse museum could scarcely boast a better address. But where, bureaucrats wondered, would the money come from to set it up? Bienaimé's surprising and winning answer: he would finance the place himself, by selling his house and his biggest and best riding club.

"I put my entire fortune into this," he says. "More than $500,000, and in a country that had just gone Socialist." Bienaimé persuaded his old employer, the Cercle Hippique, to quit the premises several years before its lease expired. He wangled a promise from the national stud farm in Normandy to provide him with stallions to serve as living exhibits of each equine race raised in France. By January 1982 the last obstacles fell away. For ten percent of any profits that might be made, the Institut agreed to put the Grandes Ecuries in his hands for 20 years. Chantilly was already renowned for its chateau, its 15,000-acre forest, its lacy history and, *bien sûr*, crème Chantilly. Now it was to get another attraction, a Living Horse Museum.



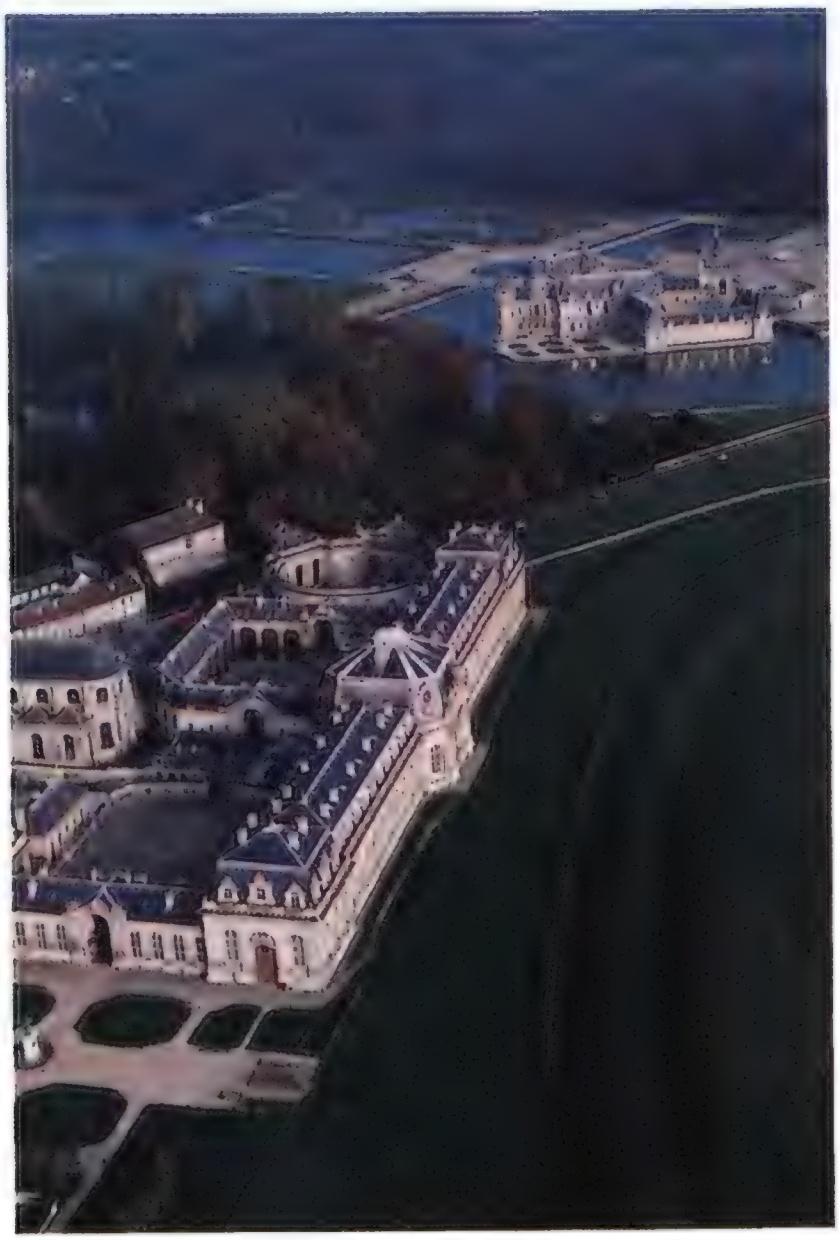
Robert Ladou, noted horse painter, touches up one of more than 280 pictures he did for the museum.

Bienaimé took possession on February 1. "No one believed me when I said I'd have it ready for opening June 6," he recalls, "but I did. If the administration had been handling it, they would have needed a couple of years."

Armed with optimism and 30 workers, Bienaimé waded into the formidable task of shaping up the place, inevitably under a barrage of jokes about Hercules and the Augean stables. Having no nearby river to divert through these stables, Bienaimé and his men cleaned by hand, scraping away centuries-old grime, tossing out mountains of trash, and repainting woodwork in *ventre de biche* (doe's belly), a reddish-beige that was the Condés' family color.

"The place was just falling apart," Bienaimé says. "God knows what it would have looked like in another 20 or 30 years. The government didn't give me a centime in subsidy. I did everything myself." The result was a fiscal anomaly: a national museum, officially under the aegis of the Institut de France, yet entirely financed, organized and managed by a private individual. But, given the present state of the French economy, there was probably no other way the Musée Vivant du Cheval could have come about.

In the hospital, papier-mâché patient is strapped to hydraulic table that can tilt 2,000 pounds of horseflesh.



Backed by courtyards, the two long wings of horse museum face racetrack. Chateau and lake are beyond.

A congregation of hounds waits to be blessed in outdoor mass at the Abbey of Chaalis near Chantilly.

Even so, with individual entry fees set at 25 francs (about $3.50), Bienaimé will be a long time recouping his investment. The 11 months since the museum opened have brought only an estimated 90,000 visitors. But Bienaimé foresees a steady flow of at least 200,000 a year, now that the Grandes Ecuries are known to the tourist industry and the concièrges of Parisian hotels, who make or break such attractions. The clientele will change, too. His first year, ending this June, saw mostly French, Dutch and Germans; he soon expects a satisfyingly heavy influx of Americans, Japanese and Scandinavians as well. Bienaimé even hopes that one day Chantilly will be up there with Versailles and Chartres as a must for visitors to Paris.

By some inexplicable Gallic legerdemain he now manages the whole cavernous building and its attendant display rooms, offices, courtyards and riding rings with only three employees, plus his wife and 16-year-old daughter—when they happen to be free. Casual phone calls to the museum are likely to reach Bienaimé himself, rather than a switchboard operator. Anyone visiting the place is as likely to come across the curator afoot, sweeping the floors, as *à cheval*, giving a demonstration of dressage.

Bienaimé astutely set up his museum so that visitors enter through the east wing, past the chateau, gloriously attractive on its watery site. The elegant, 19th-century racetrack—miles and miles of lush lawn often populated by training thoroughbreds—sits off to the left. Everywhere else stretches the forest, slashed into geometric sectors by sandy 18th-century alleyways and promenades (left).

For his admission fee, a visitor is given a three-part presentation: a tour of the two wings and the central ring under the dome; a look at the display rooms and former coach houses; and a demonstration of dressage, performed in summer in a colonnaded outside ring, and in winter beneath the great dome itself.

The east wing is mainly living quarters for the various breeds of horseflesh raised in France: work animals like Ardennais, Breton, Boulonnais and Percheron and Auxois, as well as Arabians, English thoroughbreds, French saddle horses, Lusitanian Jabadaos, Cobs, and even the white, ponylike Camargue. All horses on display are stallions, a bit of arrant sexism that may yet land Bienaimé in hot water with the equine liberationist crowd. These noble beasts, most

The author, who last fall wrote about growing up with a pet crow, lives an hour's drive from Chantilly.

Ceremony is part of annual day-long fête in honor of St. Hubert, France's patron saint of the chase.

St. Hubert's Day dinner is given under stable dome, where Condé entertained future Czar of Russia.

of them on leave from the national stud farms, live like maharajas compared with their brethren in most Yahoo-run stables. Their daily diet is as rich and varied as any sophisticated Houyhnhnm could want: molasses-sweetened chaff, linseed, barley, hay and carrots, now and then supplemented by the odd sugar cubes and apples smuggled in by soft-hearted visitors. The easygoing attitude of Bienaimé and his small staff allows visitors to get very close to the living exhibits, a proximity astonishing in a country where children are taught from toddler age *never* to walk on the grass.

In the west wing the ancient stalls have been cleared away to make room for 20 full-size model horses variously caparisoned in historic harness. They represent different equestrian disciplines, ranging from flat racing and show jumping to polo and dressage. Later, Bienaimé hopes to add more disciplines from overseas, especially from Asia and America: quarter-horse racing, cowboys, gauchos, and so on. "I didn't dare put cowboys in there at first," he admits, "because they are looked upon with disfavor by the horsy set in France. Cowboys in the Condé's palace are vulgar and shocking to them, but *tant pis*."

A vaulted passageway through 15 feet of solid stone (Aubert built to last) leads visitors to an audiovisual room, a model smithy (p. 64), a veterinary room with operating table and a full-scale model patient (p. 65), plus a roomful of equine toys dating back 300 years.

The unquestionable star of the exhibit space is Robert Ladou (p. 65), a 53-year-old former show jumper and gentleman jockey from Fontainebleau. Ladou has been a full-time painter ever since an unobliging mount threw him into the timbers of a jump and rearranged his leg. At Chantilly he has meticulously researched and painted the large wooden panels that now fill three of the museum's rooms. Working day and night to meet Bienaimé's opening-day deadline, he produced a series of 44 splendidly detailed panels that combine esthetics with the kind of didactic accuracy necessary when pictures are used in the hippology courses for the apprentice jockeys working for their licenses at Chantilly.

Ladou's panels retrace the history of horses and horsemanship, demonstrate anatomy and bone structure and, step by step, show the everyday care needed to keep horses healthy and happy. He is proud to be the undisputed champion of French equestrian painters, but the pressure of work has been so great that he is now planning a long vacation from horses, and expects to soothe frazzled nerves by painting landscapes.

Beyond the display rooms, in the cobbled courtyard

How Chantilly got its old, new horse museum

Sunlight streaming through the 20-foot-tall doors of museum silhouettes statue of famed Arabian horse.

where the ladies' carriages used to gather for the hunt, visitors pass the oversize kennels where the Condé once kept 500 hounds, and make their way to the outdoor ring, where usually either Bienaimé or daughter Sophie gives demonstrations of dressage. French traditionalists insist on shouting their lungs hoarse, as they try to explain what they're doing during such demonstrations, but Bienaimé, an innovator, rigs himself up with a transmitter microphone and speaks through loudspeakers set in among the colonnades. As his mount prances and wheels to all but invisible commands of thigh, hand and knee, he is able to give a calm-voiced and understandable explanation of the subtle secrets of this ancient art.

A lot more will be going on around the Grandes Ecuries in the future. The kennel courtyard will be arranged as a replica of the royal Ecole de Versailles, a school for dressage that was destroyed in the Revolution. He is also working on cooperative exchanges with horse museums in other countries; especially, he hopes, with Kentucky Horse Park in Lexington, the largest in the world.

"I've got this amazing place in my hands for 20 years now," says Bienaimé as he strides through the echoing immensity of his museum, his booted step ringing from the walls. "That's not much, 20 years. By the time it's over I'll be an old man. But by then I want to be able to leave France with the biggest and the best horse museum in the world." Plunging into a side door to climb the dizzying corkscrew of a spiral staircase that gives access to the base of the dome, he leads the way along the yard-wide catwalk where the musicians took up their vertiginous positions on that night so long ago during the Condé's dinner for the future Czar of Russia. Coming to a momentary halt at dead center, just above the summit of the east wing's arch, Bienaimé leans with evident satisfaction against the railing, an intruder in the coldly perfect world of Aubert's 18th-century calculations. Everything is circles and spheres: the arch behind him, the monumental dome above him, the delicate rim of the catwalk, the stone ring below him, its symmetry broken only by the formal fountain with the two great stags in bas relief on either side. It is clear that his long association with the Condé's stables has given him something of the great French prince's taste for stage setting and theatrical understatement.

"You know," he says, surveying his domain, "I could have made a museum of the horse anywhere at all. But there is only one Grandes Ecuries."

Sidesaddle, in 1800s costume, Sophie Bienaimé puts dapple-gray named Tafarito through its paces.

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By Ted Williams

Country 'doctor' helps sick streams rush back to life

Operating on his patients with backhoes and silt suckers, businessman Rich McIntyre restores magic and trout to troubled waters

On a blustery day in May, I tramped across a lush meadow near Emigrant Mountain in southwestern Montana and stood at the source of a lively little stream called Stuches Spring Creek. Amidst wildflowers and cottonwood trees, Stuches' icy waters welled up out of the ground to form a deep, dark pool before rushing off to the Yellowstone River a mile away. Peering into that pool, I could see black clouds of tiny young trout, called "fry," boiling up from beneath the undercut banks. I also detected the shadows of much bigger trout ghosting over the pond's mossy bottom.

A stream is nature's way of getting water from one place to another. If it is wide and deep, it may be called a river; if it is narrow and shallow, it may be called a brook, a rill or, like Stuches, a creek. Cold-water streams that have not been polluted or otherwise defiled are likely to contain trout—sleek rainbows, perhaps, and brook trout, or browns and cutthroats. These fine fish are lovely to look at, fun to catch and delicious to eat. A stream that has lost them is a sad thing to see.

I am a trout fisherman and what I saw in that Montana meadow convinced me that Stuches Spring Creek is a dream come true. Not long ago, however, Stuches was no mere dream; it was a nightmare. For the better part of 60 years, in fact, local ranchers allowed their cattle to wander all over the surrounding countryside. The animals broke down Stuches' vegetation, trampled the banks, waded into the water and overgrazed the grasslands, causing soil to erode into the stream. As a result, Stuches was not fit for Man or trout, of which it boasted precious few.

Then, in the summer of 1978, a brash 25-year-old entrepreneur named Richard McIntyre (opposite) arrived on the scene. McIntyre, a stocky, blue-eyed outdoorsman with thick sandy hair and a red beard, is a connoisseur of trout. He is also a stream doctor. His firm, Timberline Reclamations, Inc., nurses ailing trout streams back to health by operating on them with bulldozers, backhoes and pumps known as "silt suckers." At the request of a new landowner, McIntyre treated Stuches by rebuilding its banks, restoring its vegetation and manipulating its current with structural devices. In short order, Stuches was on the road to recovery.

Stuches is not the only moribund stream Rich McIntyre has brought back to life. Since he started up his practice five years ago, he has rehabilitated more than 80 others in 17 states, Canada and New Zealand. Timberline is said to be the only company in the country specializing in stream restoration and, with his headquarters in Bozeman and a new office in Seattle, McIntyre seems to be doing well by doing good. Last year, with 11 full-time employees, Timberline grossed about a half-million dollars. "We're successful," McIntyre says, "because we're doing something that's never been done before. We don't just look at fish, or water, or vegetation. We treat the whole patient—and we've never had one that didn't get well."

To reproduce naturally, wild trout like these need cold water, shade and a gravelly bottom for spawning.

Spoofing his entrepreneurial style, McIntyre and staff take the pulse of Poindexter Slough in Montana.

Photographs by Jack Fields

Breathing new life into sick streams

McIntyre checks an eroding bank ruined by stray cattle—a serious stream problem throughout the West.

Although you might reasonably expect a specialist capable of performing such wondrous environmental works to be praised to the skies and inundated with hundreds of new patients, that is not exactly the case in Montana. There, Rich McIntyre is a very controversial fellow. A nationally-known fisheries professor at one of Montana's state universities told me that McIntyre is a "P.T. Barnum" who does shoddy work. Some officials with the Montana Department of Fish, Wildlife and Parks write him off as an overpriced outsider who uses hard-sell techniques to hoodwink gullible clients. "He tries things that don't work and does things that don't need doing," grouses a biologist in the western part of the state.

But McIntyre has his defenders, too—bureaucrats who insist his critics are unfair and clients who are happy with his work, including a trout fisherman and ex-President in Georgia named Jimmy Carter. "McIntyre knows streams and he knows how to make streams make trout," says Montana fisheries biologist Ralph Boland. "It's important work. The state is only dabbling in it but he's out there actually doing it."

Sour grapes, pizza and the curse of big money

Most of the fuss over McIntyre probably derives from official sour grapes. I know something about people in state fish-and-game departments because I was one of them for five years. They are a dedicated bunch. They are also overworked and underpaid. Many could make more money selling pizza. It simply is not possible for them to look objectively upon a young upstart making big money from something they regard almost as a religious calling.

But there is more to it than that. Streams are inherently controversial because they are very important to a great many people. They feed the rivers that provide the water for massive hydroelectric and irrigation projects. They supply drinking water for livestock—and people. They are critical to watershed management, to wildlife and to more than ten million men and women who enjoy fishing for trout. In their pursuit of that singular pleasure, American anglers spend about $250 million annually on licenses and related fees. Trout streams are, therefore, a significant source of federal and state revenue as well as vehicles for public recreation.

Many states have inventoried their trout streams and the numbers are impressive. Wisconsin, for example, has more than 2,600, covering 9,500 miles. Wyoming's 2,000 streams provide 15,000 miles of trout habitat. Montana probably has the best trout fishing in the lower 48. Tucked within the crevices and folds of its rugged terrain are 3,900 creeks and rivers, including many of the most hallowed trout streams in the world:

the Gallatin and the Jefferson, the Madison and the Big Hole, the upper reaches of the Missouri, the Bighorn and the Flathead. There are innumerable smaller streams, too—streams with wonderful names like Spotted Bear, Red Meadow and Teepee Creek.

Even though the United States still contains plenty of fine streams, there are nowhere near as many as there used to be. In this century, agriculture, timbering, mining, road construction and urban development have obliterated many streams and blighted countless others. In Montana, where two state laws are supposed to protect waterways, more than 2,000 development projects in the past 20 years have severely damaged a number of them.

It has always seemed odd to me that Americans will pay enormous sums of money to protect things like golf courses, and virtually nothing to protect trout streams. We just let them go. And when they are gone, the people who permitted it to happen ask the state to make the trout streams all better again by putting trout back into them. The state obliges and life goes quietly on, except that the tame creatures the state raises in hatcheries are no longer trout and the places that are stocked are no longer trout streams.

The problem is that hatchery managers and nature select trout for different, often opposite, reasons. To survive in their natural element, trout must be quick, efficient predators and shy, sensitive prey. To survive in a concrete hatchery raceway, trout must accept a steady diet of Purina Trout Chow, be highly gregarious and tolerate sudden motion. Walk past a hatchery pool and the trout will swarm to your side in hopes of being fed. Superimpose these tame fish on a wild population and they are likely to spread disease or genetic defects and die before the fishing season is over. Few, if any, will survive their first winter.

Doc McIntyre versus the machine

Trout stocking began many years ago when fishing pressures threatened, or so it seemed, to outstrip the resource. But now the number of trout caught in many streams is actually inverse to the number of trout stocked. When Montana stopped stocking the Madison River in 1972, the trout population almost tripled. Nevertheless, stocking seems to have acquired a powerful momentum of its own. "The whole thing is sustained by a massive political machine," complains Rich McIntyre.

McIntyre is taking on that machine. His speciality, restoration, is the only alternative to stocking. The goal is to enable streams to produce truly wild trout on their own. Restoration is not a new idea. In the 1930s the Civilian Conservation Corps (SMITHSONIAN, April 1983) made structural improvements in streams throughout the West and Midwest. In the 1940s and '50s, a number of states got involved and more recently the U.S. Forest Service launched a big push. But with federal funds in short supply these days, the states are on their own and, consequently, little is being done. Wyoming and Wisconsin are reputed to be the leaders in the field. Wyoming, however, assigns only one crew to handle stream-restoration work. And although Wisconsin earmarks all of the proceeds from its trout-fishing licenses specifically for restoration, last year that was enough to rehabilitate just 20 miles.

Awash in Golmeyer Spring Creek, McIntyre and aide Dale Miller (left) clear brush blocking the flow.

To produce trout, a stream requires clear, cold water (anything warmer than 77 degrees F will not do), plenty of oxygen, adequate shade and shelter, plus lots of insects. Gravel beds are essential for spawning because female trout use gravel to cover their fertilized eggs. And a swift current is needed to keep silt from smothering the buried eggs. These are the conditions Rich McIntyre seeks, in ways both ingenious and crude, to re-create.

Some streams never had trout and never will. No amount of engineering, McIntyre emphasizes, can create a potential that did not exist in the first place. But almost any stream that once produced trout can, no matter how badly abused, produce trout again—if the owner is willing to pay the price.

The price is high. One Montana expert puts the cost of rehabilitating steep streams there at $50,000 a mile,

Ted Williams' article on Atlantic salmon appeared in the November 1981 SMITHSONIAN. *He prefers fishing to baseball, which he stopped playing in junior high.*

Log deflectors in Stuches Spring Creek constrict the flow to make the pools and riffles wild trout need.

Head to head, McIntyre (right) and Steve Fisher study bottom-dwelling insects to gauge a stream's health.

and McIntyre charges around $30,000 to $40,000. Stream restoration is so expensive because major construction work is usually required.

Most of the nine streams that McIntyre has worked on in Montana are relatively small, flat spring creeks in the valley. One day he took me out to see some of them. The first stop was Golmeyer Spring Creek (p. 75), a Yellowstone River tributary about 25 miles from Livingston. In the 1940s, a rancher did away with Golmeyer altogether by shunting it into an irrigation ditch. Four years ago, the new owner called in Timberline to perform radical surgery.

Building "fish ladders" to help trout get about

Golmeyer is small even by spring-creek standards—only three miles long and narrow enough, in places, to jump across. But as resurrected by McIntyre, it is clearly a going trout stream. The job called for creating an entirely new channel, building fish ladders so trout could get to and from the Yellowstone, constructing shelter platforms, and putting small dams in the stream to obtain the alternating pool-and-ripple habitat trout do best in. After revegetating the banks with native grasses and shrubs, McIntyre introduced water into the channel in the summer of 1980. Just ten months later, Timberline took a census of the fish in Golmeyer which indicated that as many as 110 brown, brook and cutthroat trout more than six inches long might be inhabiting every 1,000 feet of the stream. That is a lot of fish.

McIntyre, who has a tendency to exaggerate when it comes to fish, told me he could practically guarantee that a couple of dozen trout (well, maybe a dozen) were holding under each platform. These structures had been planted with willows and cottonwoods that were still enclosed in four-foot-high wire cages. The cages protect the saplings from hungry white-tailed deer. But just about the time the trees are large enough to survive the browsing, the wire will rust away. And a few years later, when the trees' roots have thickened and flared out through the whole platform, the last of the log supports will rot away.

What you will have then is a shady pool and a deep, undercut bank made deeper and darker by the gnarled, living wood that holds it. The trout will hover between the roots, dashing out, now and again, to snap up nymphs. Maybe a muskrat will build in the bank. A tanager may nest in the high, spreading branches. Bats, swifts and swallows will gorge on the new insect life. And Golmeyer will be a place fit for people, too—not only to fish but to walk, sit, watch and listen. Thus does Richard McIntyre restore magic and mystery along with trout.

The magnitude of Timberline's accomplishments

Prey for trout: at top, a sculpin; center, crane fly larvae and, center bottom, a stonefly nymph.

did not fully dawn on me until the day after I saw Golmeyer and Stuches, when McIntyre took me on a tour of ruined streams. The most tragic example was a section of Thompson Spring Creek, which meets the East Fork of the Gallatin near the little town of Belgrade. Not one shade-giving tree or shrub survived on its banks. All had been pounded down by cattle. The sides of the stream were falling away in chunks—dirt glaciers calving dirt icebergs into a dirty sea. The stream was six inches deep and 30 feet across, with a bottom of boot-sucking silt and silt-cemented gravel, useless for spawning. In half a mile, we did not encounter one square inch of cover that could hold a trout or feed the fantasies of a fisherman. "Grotesque," McIntyre called it.

It is said of Rich McIntyre that he has a passion for profit, as if this were a sin. He is, after all, a businessman, and if he is able to make money reclaiming streams for well-heeled clients, he is a far better friend to trout than all of those government agencies that do nothing at all. But McIntyre cares about the land, too, and he worries about what people are doing to it. He has been agitating for years in Montana for tougher zoning laws to stem the pell-mell subdividing of the Yellowstone Valley. That has not endeared him to independent-minded local folks who oppose zoning of any kind.

McIntyre grew up on a farm outside St. Louis and has been obsessed with fish and fishing since he caught his first rock bass at age three. He reckons his firm would not have happened at all had it not been for his two grandfathers. "One taught me a respect for the land and how to reclaim it," he recalls. "The other taught me a respect for water and fish. The fishing grandfather used to take me down to the Lake of the Ozarks every summer, and we'd go night fishing. We'd hang a couple of lanterns off the end of the boat and the bass would be attracted by the light. I remember those star-filled skies very, very clearly, and how excited I would get when I caught those bass. Some nights we would catch 150."

A hundred and fifty? Really and truly?

Jimmy Carter just loves the way McIntyre exaggerates about fish. A couple of years ago, McIntyre and the former President were flycasting in Montana's Poindexter Slough, another Timberline patient. McIntyre distinctly remembers hearing an unmistakable soft Southern voice coming from somewhere out in the middle of the stream: "Rich, ah, Rich. Come on over heah and measure this trout. I like the way you measure my trout."

Carter was impressed with McIntyre's restoration work on Poindexter (p. 72), and the good fishing it provided. Recently, in fact, he hired the firm to do some refurbishing on his private trout stream in Georgia's high country.

Why, you might ask, when so much else ails the world these days, do people like Carter and McIntyre, and ordinary anglers like me, get so worked up about trout? It is not an easy question to answer. Part of the answer has to do with the fact that trout are not mere fish, nor are those obsessed with trout interested in mere sport. John Voelker, the author (under the pseudonym Robert Traver) of *Anatomy of a Murder* and a noted trout fisherman himself, puts it this way in another of his books, *Anatomy of a Fisherman*: "Trout, unlike men, will not—indeed cannot—live except where beauty dwells, so that any man who would catch a trout finds himself inevitably surrounded by beauty: he can't help himself."

Trout, in other words, are indicators of the quality of our environment. If we can make the Earth fit again for creatures like trout, then we make it fit again for people. That is why Rich McIntyre's work is important not only to fishermen but to every man, woman or child who has ever loved a stream and returned, one day, to discover that it was gone or ruined.

Before I left Montana, I suggested to McIntyre that I could not vouch wholeheartedly for his work until I had sampled it with a fly rod. The stream doctor took me to Poindexter Slough, handed me a box of artificial nymphs called "Woolly Buggers" and excused himself to herd some cows out of the area.

I could see Poindexter healing. In the fast water below McIntyre's stepdams and deflectors, gravel crunched beneath my feet. I probed the dark, mysterious water below the riffles and under the habitat structures with my Woolly Bugger. As it tumbled in freefall, wild brown trout rushed to intercept it. They were deep-bodied fish, splashed with ruby and sapphire, and the trim on their underfins matched the quartz in the stream bed. Before I released them, I held them a long time in the finger-numbing current, harvesting a little of Poindexter's new magic.

Wetting a fly in a McIntyre-improved stream, angler wades in natural splendor above an artificial dam.

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The first American production sports car hit the streets in 1953. And the legend immediately took charge, stirring the souls of driving enthusiasts from Woodward Avenue to Van Nuys Boulevard.

The name "Vette" embodied all the freedom and romance of the '50s and '60s, typifying the American life-style–fast, young and sexy.

But there's a new Corvette on the scene. And it's the most comprehensively packaged automobile of all time. One with advanced styling, innovative engineering, high technology, quality and comfort. This is the story behind the new Corvette. And that is what it takes to be the best production sports car in the world.

The culmination of 30 years of evolutionary engineering dedicated to the one true American sports car.

We are committed to excellence in production, in order to achieve excellence in the product itself. Each morning, a select group of salaried and hourly employes meets to examine the cars in detail and search for ways to assure and enhance the quality of the new Corvette.

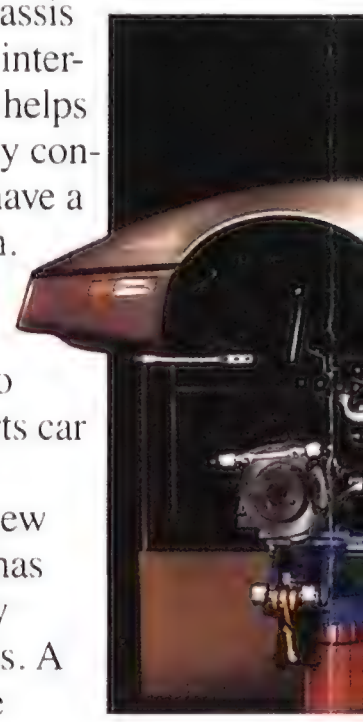
The quality starts from the inside out. A match check frame serves as a full-size "blueprint" to check structural parts to minute tolerance limits.

The galvanized steel uniframe has been engineered to be light in weight yet stiff in beaming and torsioning. This rigid structure is vital to the sports car ride and handling achieved in the new Corvette.

One of the hardest workers on our assembly line, a two-stage automatic welder, produces a precision skeleton as it "builds" the new Corvette uniframe, applying 142 accurate welds in 97 seconds.

The solid fiberglass body continues to be one of the most enduring qualities of the Corvette. Advanced techniques have provided a smoother degree of beauty this year.

A hydraulic towveyer system in assembly is specially built to marry the chassis to the body. Its interlocking system helps assure that every contact point will have a precision match.



It takes design sophistication to be the best sports car in the world.

And the new Corvette has some very quick lines. A most acute windshield rake for a production car, front and rear side-mounted cornering lamps, twin sport mirrors that are electrically adjusted and aerodynamically shaped and four functional circular taillights are among its many design features.

The new Corvette was shaped in GM's wind tunnel for the lowest drag coefficient of any Corvette ever tested: .341. Advanced methods of monitoring turbulence as it relates to a moving car were employed to achieve wind assistance, rather than wind resistance.

With most hidden headlamps, when you flip the lights up they act as air brakes, and all those late nights designing an aerodynamic hood were in vain. But on the new Corvette, the retractable headlamps

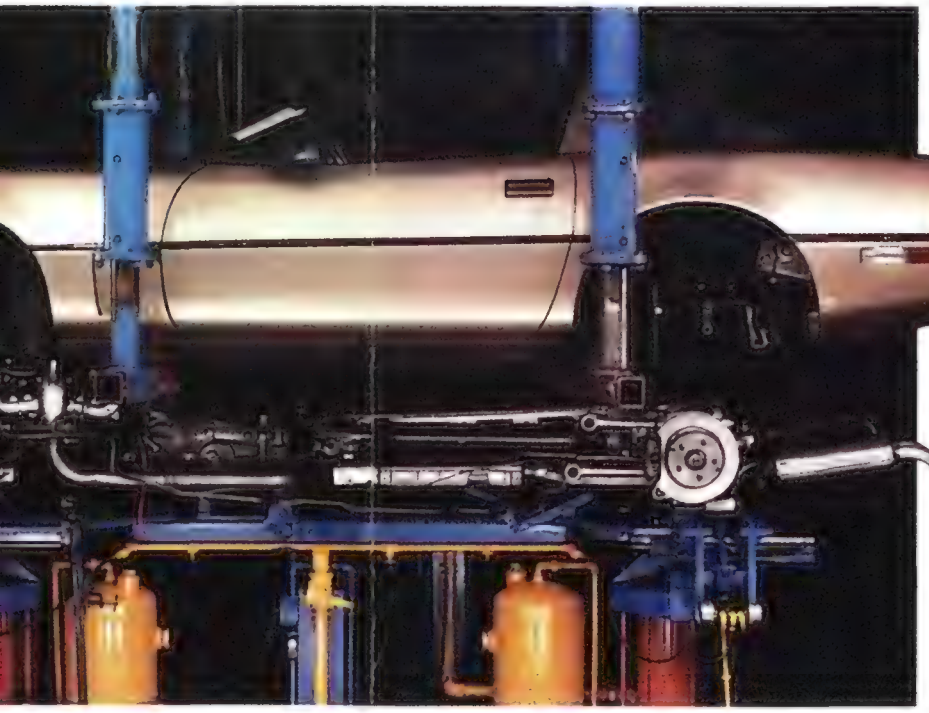
The pride of Chevrolet is its people. This dedicated team is using vast technological resources to build the legend that will reaffirm your pride in American ingenuity and skill.

E BEST PRODUCTION SPO

roll forward 158 degrees with authority and are teardrop shaped so that this Vette will slip through the wind at night and during the day.

The frameless rear glass hatch opens wide when you activate an interior switch to provide convenient access to the rear compartment.

The front and rear integrated bumper system on the new Corvette is an excellent example of

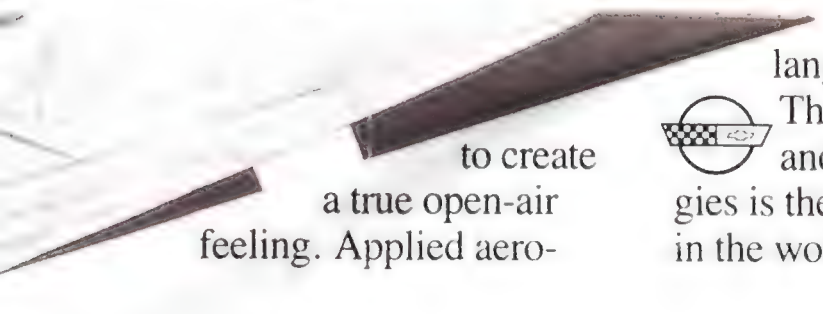


the "designed-in" rather than "tacked-on" approach to automotive design. Energy from a low-speed impact is absorbed by the system, which assumes its original shape after the pressure of impact is released.

The bold black protective side molding is designed-in to cover the only horizontal body seam.

The clamshell hood, a design seen on many of the world's great racetracks, can now be seen on the street in the new Corvette. The hood and front fenders open forward for easy service access to the engine and front suspension.

Lift off a full-width, one-piece fiberglass roof section



to create a true open-air feeling. Applied aero-

dynamics help reduce cockpit turbulence. And the top stores conveniently in a rigid lockdown position in the rear compartment when you're riding with the wind and bolts securely into place with a special wrench when there's stormy weather ahead.

Don't worry if you find yourself in a fog. The halogen fog lamps will help you see in foul weather.

The inner space of the new Corvette is a very pleasant environment in which to conduct the business of driving. Some of the standard features include air conditioning, tilt and telescoping steering wheel, power windows, side window defoggers, and windshield wiper and washer controls which are mounted on the driver's door for easier access.

The ergonomic design of the seats and seat belt system holds you in position and conforms to the curves and contours of your body as if it were individually designed for you.

The space-age instrumentation of the new Corvette is something to behold. Electronic liquid crystals display multi-colored readouts, both analog and digital. Speed, revolutions and numeric readouts of engine and electrical conditions are provided in your choice of languages: English or metric.

The result of these new design and manufacturing technologies is the best production sports car in the world. A new Corvette with

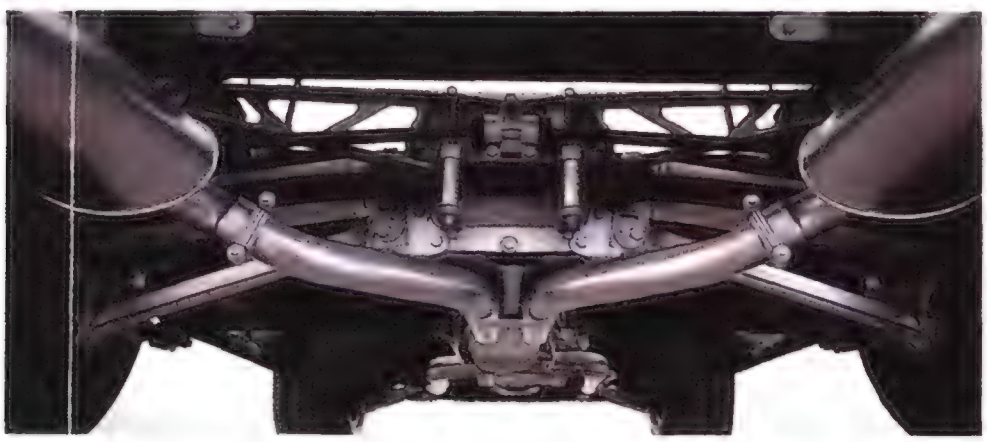
outstanding electronic technology, advanced styling, innovative engineering, impressive quality and ergonomic comfort.

Besides being the best production sports car in the world, it has remarkable handling. The suspension solution that gives the new Corvette the agility of a mountain lion features a single, fiberglass monoleaf transverse spring in front in lieu of the traditional coils. You've also got forged aluminum arms and knuckles, sta-

RTS CAR IN THE WORLD.

bilizer bars and telescoping shocks working for you.

Goodyear worked closely with Chevrolet engineers. The result is the 16-inch Goodyear Eagle VR, available on the Special Wheels and Tires Package, or the Z51 Performance Handling Package, a unidirectional tire modeled after Goodyear's Formula One rain tire found on race courses around the world. So impressive is this new technology that, once mounted, there's a specifically engineered tire for each side for a new kind of performance.



The muscle behind the motion of the new Corvette is a 5.7 Liter 350 CID twin-throttle body, Cross-Fire Injection V8. What all this means is the new Z51-equipped Vette, on the test track, can reach a top speed of 142 MPH and 0 to 60 times of 6.8 seconds. It's a new and exclusive version of our renowned small-block V8, for a completely new Corvette.

To get this power to the road, there's a 4-speed automatic transmission with overdrive. In the first three gears it performs like a conventional 3-speed automatic transmission. When the vehicle reaches cruising speed, the transmission automatically shifts into overdrive. Once in overdrive the engine turns slower and it doesn't have to work as hard. This adds up to smooth cruising with reduced engine wear.

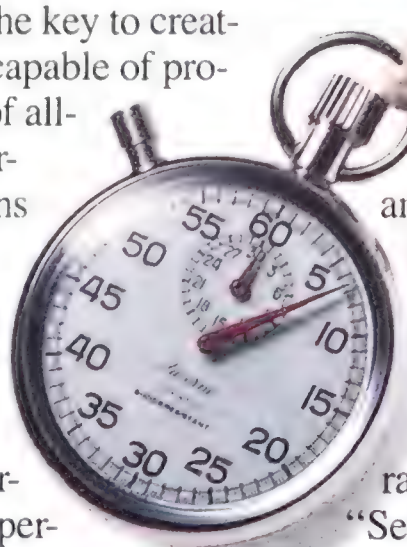
The torque converter clutch provides the convenience of an automatic transmission with the performance features of a direct drive, manual transmission.

Because a car that goes fast must also stop fast, the Girlock brake system has been introduced to the new Corvette. These high-performance brakes have 11½" discs and a low-drag, aluminum caliper design for reduced weight and remarkable vehicle dynamics. In the hands of a professional driver, on the test track the new Corvette can go from 0 to 100 MPH and back to 0 again in 22.4 seconds!

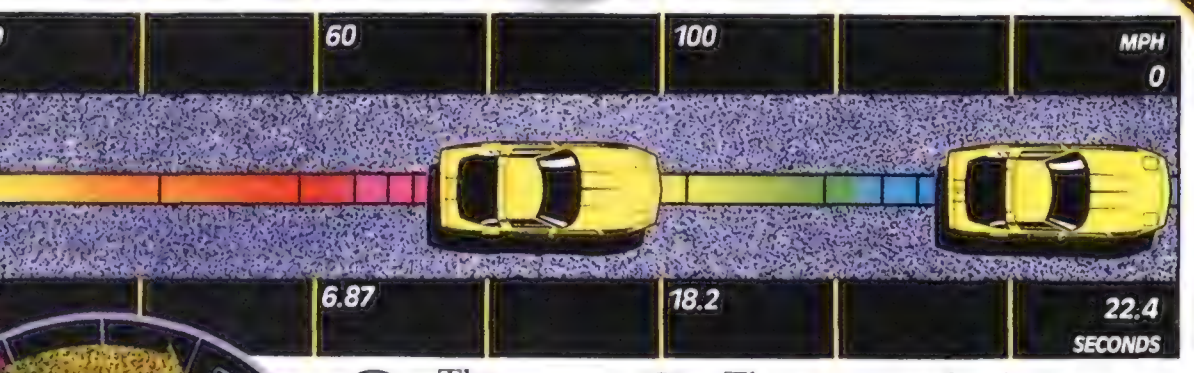
Lateral acceleration is a critical test of a sports car's cornering capability. With the available Z51 Performance Handling Package, Corvettes were reaching lateral forces of .95g's in tests on GM's skidpad. This is a remarkable achievement for a car designed for grand touring.

THE NEW CORVETTE.

Balance was the key to creating a vehicle capable of producing a high level of all-around sports car performance. This means virtually an equal weight distribution on all four wheels of the car, resulting in remarkable braking, acceleration, cornering, straight-line performance, overall ride and comfort.



The acoustics experts at Delco and Bose have combined forces to create a 5-unit, wraparound sound system so advanced, so unique, so tailored to the new Corvette interior that amplifier/speaker modules would have to be modified if the nap of the carpeting were changed. This optional system includes an AM/FM stereo ETR™ radio with digital clock, "Seek and Scan" and cassette.



The system of painting the new Corvette is one of the most advanced in the world. New paints, new chemistry and a new multi-step process in our brand-new Corvette plant are employed to achieve the beautifully radiant Corvette finish.

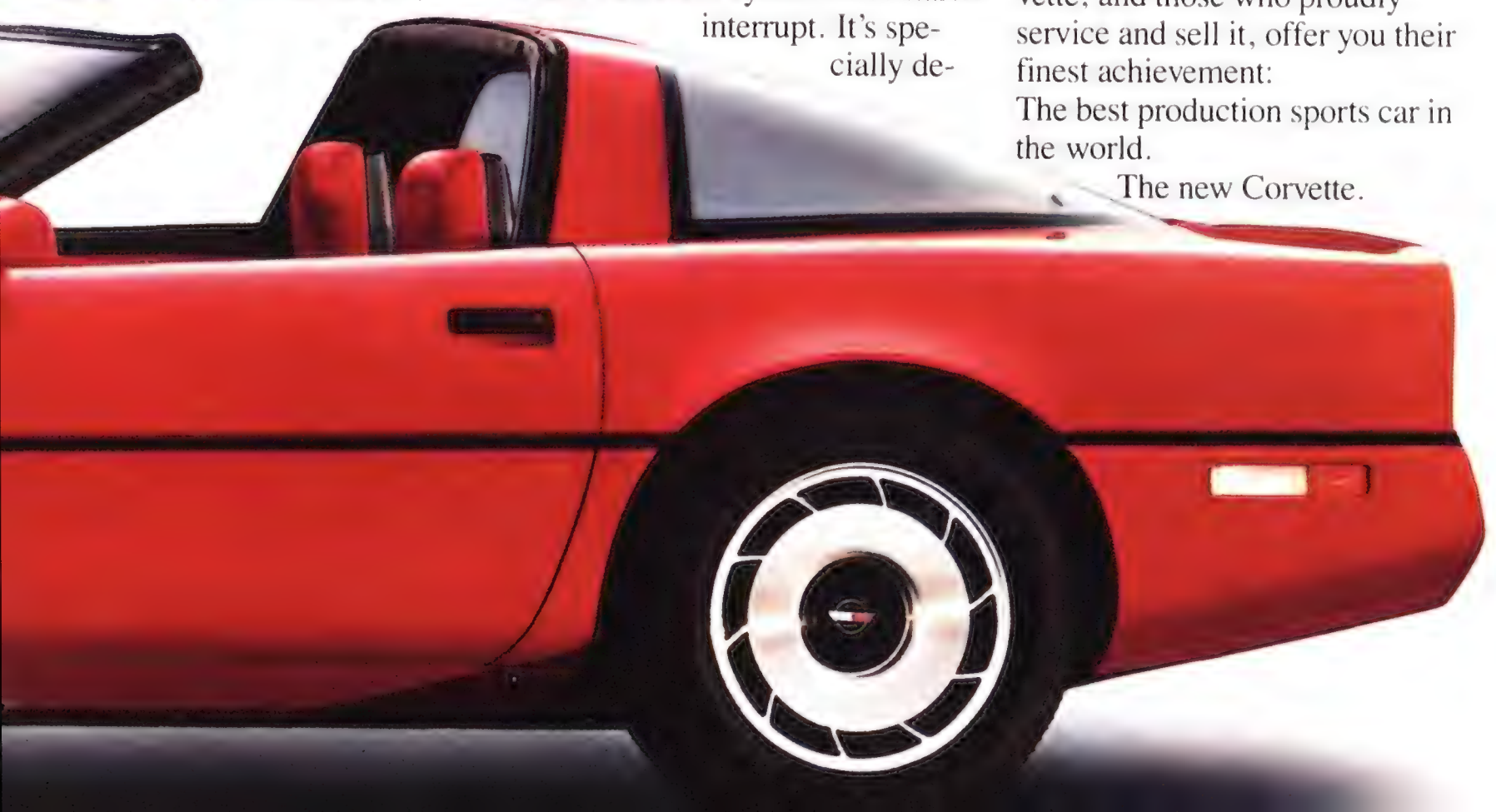
To help you protect your investment there's the Passive Theft Deterrent system with starter interrupt. It's specially designed for the new Corvette. It's also standard.

To help you protect some of your other investments, a roller-shade security panel is built into the rear compartment to keep your personal belongings hidden.

This marks the beginning of a new era in which the American automobile, by redefining the limits of gravity, space and time, has joined the elite of the exotic sports car world.

The Chevrolet family of people who have conceived and who construct the new Corvette, and those who proudly service and sell it, offer you their finest achievement:
The best production sports car in the world.

The new Corvette.



COME ON IN AND OPEN ONE UP.

USA-1 TAKING CHARGE

Chevrolet

By Edwards Park

Short, happy life of a tiny state within the States

In what is today a part of New Hampshire, an aroused citizenry, in 1832, established the independent 'Indian Stream Republic'

It's called the longest undefended frontier in the world. For some 4,000 miles it slices across North America between Canada and the United States, a border peopled with generally laid-back customs officers, and decorated with roadside signs that wish the motorist "welcome" or "*bienvenu.*" But when you focus closely on some parts of this frontier, you may discover strange skeletons in the national closets of both countries.

One long-forgotten set of bones belongs to the Indian Stream Republic, an independent nation in northern New England with a two-house legislative body, a written constitution, courts, laws and a militia. It lasted from 1832 to 1835. Then its citizens made the mistake of invading Canada and of getting invaded themselves by the New Hampshire militia. This excitement was called the Indian Stream war, and a century and a half later the descendants of the feisty participants don't seem to want to talk about it.

About a generation ago, while working on a Boston newspaper, I visited the site of the republic and dug into the story. Local people seemed to know their history all right—many had the same names as the assemblymen of the Indian Stream Republic—but they were reticent about the ancestral adventure. And when I returned to the place recently, I found most of the old people gone and most of the young ones uninterested. I felt that perhaps the story of the republic would be lost. God forbid.

After the American Revolution, the boundary be-

"Citizens made the mistake of invading Canada and of getting invaded by New Hampshire militia."

Illustrations by Arthur Shilstone

Republic extended westward from a stream that rises at the Third Connecticut Lake, to Halls Stream, the current Canadian border. Red dotted line marks additional territory claimed by the United States.

tween Canada and the New England states was set on the height of land that separates the St. Lawrence basin from the southward-trending streams that nourish Maine and New Hampshire. Under the terms of the Treaty of Paris the line was to wiggle westward, touch the "northwesternmost head of the Connecticut River," follow that stream southward to the 45th parallel and then go west along that latitude.

The trouble was, "the northwesternmost head" was hard to establish in that tangle of wooded hills. And in all that maze of boggy ponds and rain-rushing brooks, who could say for certain which was the topmost trickle of the mighty Connecticut? Britain's boundary commissioners chose the Third Connecticut Lake, as it is now called. The Americans, opposed on principle to anything their former enemies decreed, held out for Halls Stream, which rose 12 miles west of the lake. That would provide an extra slab of rich woodland—some 250 square miles of it—for the United States.

No white man lived in the disputed region, so establishing ownership didn't much matter at first. But along about 1800, land speculators managed to get grants from the St. Francis Indians. The state of New Hampshire failed to approve this deal officially, but allowed the settlers to stay on their claimed land. Part of the disputed region was known as Indian Stream after one of the Connecticut River feeders that flows through it.

Around the confluence of Indian Stream and the Connecticut was untilled bottomland that was rich and lush. It is easy to see why farmers, fed up with tilling New Hampshire's granite, came north to settle. By 1824, some 58 families lived in the territory, and no one cared if they were American or Canadian.

In addition to his regular "Around the Mall" column, Edwards Park is now working on a book about the Smithsonian Institution as a whole.

A fair number of recent arrivals moved in simply because of the ambiguous status of the place. Along with the first families—who were by nature adventurous and by necessity pretty capable backwoodsmen—there now was a new breed of sheriff-dodgers, men who for one reason or another were in trouble with authorities in either Canada or the United States and sought happy sanctuary in Indian Stream.

I was told an old story about the Coon family of Indian Stream. A Yankee peddler pushed into the region with his horse and wagon and negotiated a bargain with Mr. Coon for some metalware. "I'm a mite short of money," said the Indian Streamer, "but I'll give you a coonskin for it."

"Done," said the peddler. "Let's see the skin." Coon introduced himself and bared a hairy chest. "You kin have it ef you kin get it," he said.

Feeling a draft from Canada's militia

Coon is one of the names that figure in the early rolls of the republic. The boundary dispute had become an international problem by then. Britain and the United States had referred it to the King of the Netherlands for arbitration, and he had decided in favor of Great Britain. The big landowners of Indian Stream—the "first families"—considered themselves Americans and would not accept the decision. Neither did the United States. Yet all the people of the territory were sick of facing customs duties on their farm produce when they carted it into neighboring towns in New Hampshire and Vermont, of finding both Canadian and American lawmen on their rough-hewn thresholds with writs in hand. Two local boys had even been drafted into the Canadian militia. Indian Stream needed some sort of government.

At an 1832 meeting a committee was chosen to draw up a constitution. On July 9 (the Glorious Ninth?) the constitution was adopted by a vote of 56 to 3. The republic of the united "inhabitants of Indian Stream Territory" was established.

It never pretended to be more than a provisional government, designed to serve until national status was finally determined for good and all. But many of the menfolk who set it up wanted to see it survive so they would be left alone. Their constitution reflects this sentiment.

It is clumsily worded. The opening sentence of the preamble drones on for 463 words without a gasp for air. But it defines both a practical and highly democratic national government in capsule size. The supreme legislative power was to be vested in a council and assembly: "The council and assembly shall meet every year on the second monday in March and at such other times as the council may Judge necessary and shall be styled the general assembly of Indian Stream."

Every man of 21 or over who had lived in the territory for at least three months became a member of the assembly as soon as he took the oath. Among these assemblymen appear the names Applebee, Coon, French, Haynes, Perry, Robie, Tabor. Five councillors were chosen by annual vote. Among them Luther Parker, a storekeeper, seems to have played a prominent role in the Indian Stream Republic. The council held executive power and controlled the militia. This consisted of every able-bodied man between 18 and 50—an army of about 40 soldiers to guard an area a good bit larger than the Principality of Andorra and the Republic of San Marino combined.

Laws dealt in detail with crime—rights of the accused, proper treatment of criminals. If you were nabbed for assault, you faced not more than six months and a ten-dollar fine. There was no jail. Malefactors were kept under a huge potash kettle overturned on a flat rock. Murder rated a death penalty.

Taxes were assessed for road building and repair. A highroad to Maine was contemplated. The school system came under scrutiny to see if it needed improvement. No liquor could be sold near the Assembly Hall when the Assemblymen were in session.

Unfortunately, neither New Hampshire nor Quebec took these laws very seriously—nor did they show the slightest concern for the fact that a self-proclaimed republic now perched on their common border. Sheriffs still came to call. So did army recruiters. Frustrated by indifference, the little nation's forefathers wrote a most reasonable and statesmanlike letter to the Department of State in Washington in 1834, pointing out that nothing had yet transpired to settle the boundary and "vowing that . . . if this territory should belong to the United States, we should be under control of the Gen-

"Let's see the coonskin." Coon introduced himself, baring a hairy chest: "You kin have it ef you kin get it."

eral Government, and not of the State of New Hampshire, or any other state, until we should be annexed to some State by the General Government; in that case it will become our duty to acquiesce, as good citizens and loyal subjects."

The answer came back from the State Department: "If you are within the limits of the United States . . . it is because you are within the limits of the state of New Hampshire."

The antipathy to New Hampshire was strong in Indian Stream because of the state's reluctance to settle the old land claims from the St. Francis Indians. But a faction in the republic favored joining the state anyway. These were known as the "New Hampshire Boys." Opposing them were a number of pro-Canadians. Factionalism grew.

By the winter of 1835, emotions were running high. In March two New Hampshire deputy sheriffs entered the republic to serve writs for nonpayment of debts. One was beaten and both were driven out. Five months later the New Hampshire legislature agreed that militia might have to be sent in to back up the sheriffs. Several weeks later, a justice of the peace, Alexander Rea, across the border in Hereford, Quebec, quietly began lining up Indian Stream's pro-Canadians on the premise that he could help protect them from New Hampshire. The story is told of how the pro-Canadians tried to corner Luther Parker and his brother Asa in the family store. Luther reached for his long-barreled rifle and laid it on the counter. Asa strolled in toying with a brace of horse pistols. The delegation from the opposition yielded the floor—for the time being.

In October, a deputy sheriff from Coos County, New Hampshire, the county that claimed Indian Stream, slipped into the republic to serve a writ against pro-Canadian John Tyler. The deputy, William Smith, stopped off to enlist the help of the Indian Streamer Richard Blanchard, who was a New Hampshire Boy and thus not averse to nabbing a pro-Canadian. They went to Tyler's cabin to arrest him.

News spread through the countryside. Tyler's friends rallied. They surrounded Tyler's captors, overpowered both Blanchard and Smith, and freed Tyler, taking him across the Canadian line.

Later, in retaliation, Blanchard was taken from his house by Tyler and his friends. They had a warrant for

"Feelings were still running hot on the road, with shots fired and many stones thrown as well as punches."

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Emor Applebee hid behind a flat rock and (so goes the local story) held off the lot of them for quite a spell.

his arrest for an "unlawful" attempt to arrest a subject of King William IV. Blanchard's young son spread the alarm among the New Hampshire Boys. They grabbed muskets, scythes and pitchforks and surged off in pursuit. Without even noticing it, a number of the Indian Stream citizens thus invaded Canada, picking up volunteers from New Hampshire and Vermont who wanted to see the fun.

In Hereford they found Blanchard and the deputies who had him in custody having dinner. They did not take him then. Instead, they went back to get reinforcements. Then they raced ahead, overtaking Blanchard and his Canadian captors. "Stand, God damn you, or I'll blow you through!" an Indian Streamer shouted, waving a pistol. The Canadians stopped. Blanchard was released. The victorious expeditionary force then retired, whooping, to Parmelee and Joy's store in Canaan, Vermont, just a spit away from Hereford, Quebec.

There, the hot buttered rum flowed freely, and big burly men in homespuns yelled mutual congratulations back and forth, candles and torches flickering on their windburned faces. Meanwhile, Sheriff Smith, realizing that all this had started because he'd tried to serve a writ on John Tyler, was struck with ten parts remorse at his failure, ten parts New England conscience heeding the call of duty and 80 parts rum fumes. Then, so one story goes, he bellowed out "Five dollars to the man who catches Tyler!"

Clattering off in a second invasion

There was probably a moment of silence because five dollars was a lot of money in 1835, especially in northern New England. Then two young fellows, Miles Hurlburt and Ephraim Aldrich, remembering they had seen Tyler in Hereford, mounted horses and clattered off, up the road and into Canada. With a whoop, the rest of the celebrants set out after them.

Justice Rea may have been expecting this second "invasion," for he was patrolling the roads around Hereford with a dozen men. When Hurlburt and Aldrich rode up, the Canadians confronted them. Aldrich had a sword, Hurlburt a pistol. As Rea's men grabbed for Aldrich's horse, Hurlburt fired into the air. There was a struggle, and then the rest of the Indian Stream forces, plus various Americans, panted up. Rea took off with Aldrich after him, swinging his sword. Hurlburt followed and found that "Aldrich had Rea down, Aldrich having one hand hold of the collar of Rea's coat, and one hand hold of the hilt of his sword, and Rea having hold with both his hands of the blade of Aldrich's sword, with the point of it sticking into the ground, and Aldrich was kicking Rea in the side."

Rea gasped out "I surrender." Aldrich said, "Then

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Canadian Club Solid Gold Sweepstakes

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OFFICIAL ENTRY

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"Loggers rode great rafts down the Connecticut on the long spring drives to the mills of Massachusetts."

let go of the sword." And so on. A bit like a fourth-grade battle at recess. Finally, Rea was persuaded to let go of the sword blade and was grabbed and put in a wagon. Feelings were still running hot along the road, with a couple more shots fired and many stones thrown as well as punches. Two men were hurt slightly. The sight of blood apparently sobered the Indian Streamers, for they forgot Tyler, whom no one had seen, and bundled Rea back to Parmelee and Joy's. There, they patched his scalp wound (and presumably his hands, cut by that sword blade) and released him on the advice of a lawyer who labeled them a pack of fools.

The Indian Stream war brought the republic the recognition it would never have achieved peaceably. New Hampshire's Governor William Badger had already ordered the 6th Company of the 24th Regiment of militia to encamp at Stewartstown, a few miles south of the Indian Stream border. Now he gave the nod, and the militia moved into the republic, about 50 armed men, stepping along the bank of the Connecticut. They tried to arrest Emor Applebee, and that staunch pro-Canadian hid behind a flat rock and (so goes the local story) held off the lot of them for quite a spell before they dragged him away.

The British huffed at the "irruption . . . of armed citizens of the United States . . . for the purpose of carrying [off] several of His Majesty's subjects."

Things cooled down when, in the spring of 1836, the citizens of the republic accepted the fact that they were part of New Hampshire. Luther Parker, a relative of the Parker who stiffened his minutemen at Lexington in 1775—"If they want a war, let it begin here!"—packed up and went west to resettle in Wisconsin.

Much attention was focused on the New England border, especially after Maine almost went to war with New Brunswick in 1839. Finally the Webster-Ashburton Treaty of 1842 settled the matter once and for all. The American claim of Halls Stream as New Hampshire's northwestern boundary was officially accepted. By then, the Indian Stream Republic had been incorporated as the town of Pittsburg, still there, and unaccountably pronounced "Pitchburg."

In area, Pittsburg is New Hampshire's largest town. The number of residents—about 900—isn't that much more than when the place was a nation. Timber is their wealth. During much of the 19th century, loggers rode the great rafts down the Connecticut on the long spring drives to the mills of Massachusetts. Now it's pulpwood that's wrenched out of the evergreen forest.

The rich, serene meadowlands where Indian Stream meanders toward the rushing young Connecticut have changed little since the republic. The first time I visited there, I met a descendant of Sheriff Blanchard fishing in the stream. The town clerk of Pittsburg introduced me. His name was French.

Near that meadow is the Tabor-Grey house, one of the finest in town. Parker Tabor died not so long ago. The Robie family rents out hunting-and-fishing cabins. The old Perry house was still standing when I was first in the region. I didn't see it last time. Winters are hard on houses up in Coos County. "Ten months of winter and two of hard sleddin'," people say.

Applebee's rock is still there. But most Applebees had apparently moved away before the 1850 census was taken. Two Aldriches show up on those rolls, but no Hurlburt. As for "Squire" Rea, I could find no trace of his tombstone over in Hereford, Quebec.

I followed a road along the American side of Halls Stream and saw a dozen places where I could have crossed that little brook illegally into Canada. Then I crossed legally from Canaan, Vermont. A Catholic church stands on the site of Parmelee and Joy's, where so much joy was dispensed that frosty day in 1835.

In a lot of ways, the republic wasn't a bad idea, considering the mess that border was in. It's still pretty confusing. Right near Canaan is a little slice of land called The Gore. It lies between the Connecticut River and Halls Stream, so New Hampshire claimed it. But it's also south of the 45th parallel border of Vermont (which, incidentally, isn't quite on the 45th parallel because surveying instruments weren't all that accurate in the 1840s). So Vermont had a claim. The dispute wasn't settled in Vermont's favor until 1934.

And that gives rise to the story of the old woodsman who lived there. Apocryphal, but nice. He was told that he was now a Vermonter. "By the Godfrey," he said, "I'm glad to hear it. Couldn't 'a' stood another of them New Hampshire winters."

At Parmelee and Joy's, "hot buttered rum flowed freely and big burly men yelled mutual congratulations."

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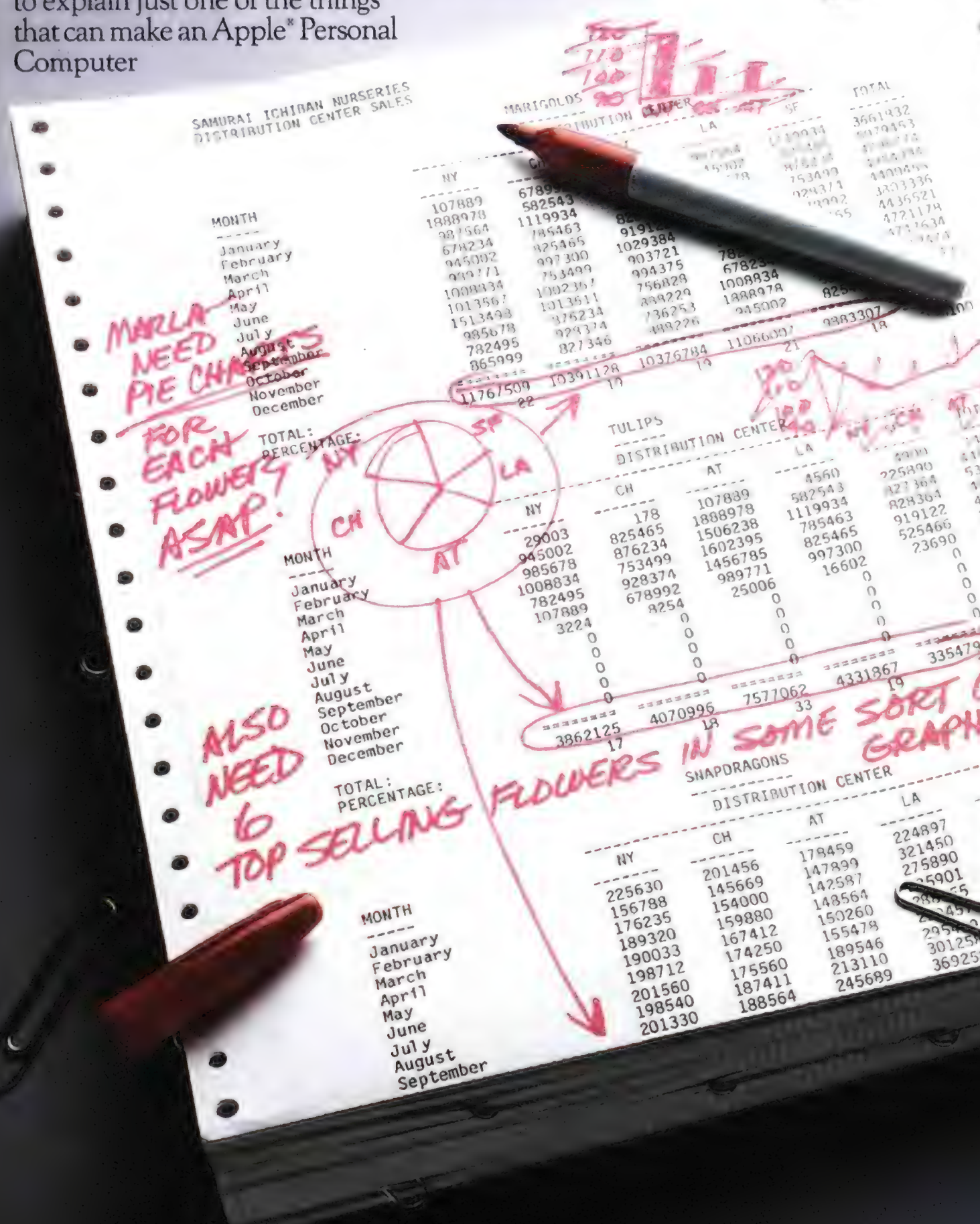

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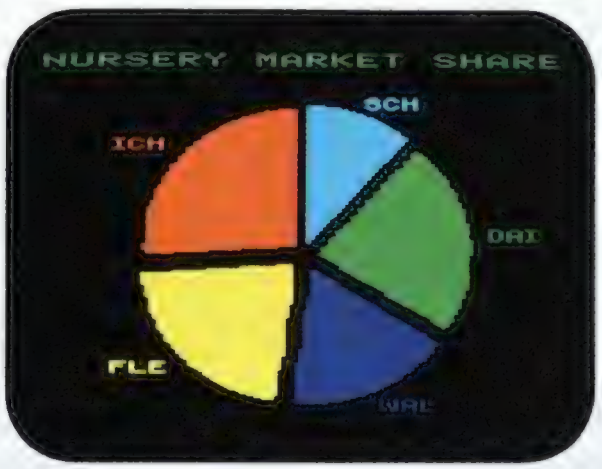

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By Michael Olmert

In Winterthur's splendid rooms, furnishing is art

With an unerring eye, Henry F. du Pont transformed his family estate into one of the world's most remarkable museums

There he was in Bangkok, just another American tourist out in the cool of the evening. It is easy to reconstruct the scene: the stately gentleman is wearing a Panama hat and a pale linen suit. He smokes a Havana cigar. Suddenly, a glint from a storefront display catches his experienced eye. A pale-mulberry 19th-century Staffordshire china tureen, partially hidden in the window among Oriental curios and gewgaws, is the source of his interest and delight. In an instant, the passive tourist is transformed into a passionate collector, for the piece is the perfect fellow of a set of china he already owns back in his Delaware mansion. He snaps it up and brings it home.

That man was Henry Francis du Pont (known to his friends as Harry) and, as the Bangkok story illustrates, he had a good eye. He also had an impeccable sense of color and form, and a scholar's penchant for detail and precision. What he did with those talents, and his family fortune, is more than just another American success story. In the case of this particular du Pont, a century and a half of family moneymaking was converted, *pro bono publico,* into a rich resource for the study of American culture. It exists today as Winterthur Museum and has been correctly dubbed the world's largest and finest assemblage of American decorative arts.

Furnished in Philadelphia Chippendale, Port Royal Parlor is one of the most beautiful of its period.

Photographs by Robert C. Lautman

Building complex now includes museum (center), storage, research, education and laboratory facilities.

Much admired by visitors is the cozy courtyard that brings together the facades of four restored buildings.

Winterthur is situated on 693 acres, including some 23 miles of roads and paths. The museum has been expanded over the past half-century to the point where it now encompasses a mind-boggling 196 period rooms, most of them for the display of furniture and other American artifacts ranging from roughly 1640 to 1840. Major collections include furniture, pewter, silver, ceramics, glass, prints, paintings, textiles (needlework, rugs) and wallpaper—71,000 items in all. Winterthur opened to the public in 1951, and has grown in popularity to the point where 295 full-time employees and 148 part-time guides are needed to serve the 150,000 people who annually pass through the estate. The museum is so big (eight stories on its downhill side) and its collection so valuable that it maintains its own fire department, complete with a cherry-picker truck to reach the highest floors.

But decorative interiors are much more than furniture, rugs and *objets d'art*. So Harry du Pont collected "rooms." He felt that the most important element was the room itself—paneling, ceiling decoration, mantelpiece, mantel pediments, cornices, window treatments, chair rails, flooring, and more. Du Pont's major contribution was thus in preserving unique examples of the best of those. His practice was to be on the lookout for old residences in decline or slated for demolition. He bought the best that were available: a room from the modest 1684 home of an Essex, Massachusetts, carpenter; a 1772 Charleston drawing room, high-ceilinged and airy; an elegant drawing room from a Balti-

more townhouse, obviously a patrician's lair from the early 19th century. Only in these authentic settings did du Pont feel comfortable placing his priceless antiques.

Actually, the word "antique" is a belittling misnomer when it is applied to the Winterthur collection. Call them decorative arts. Or museum pieces. For the Winterthur collection is just that: an assemblage for the study of early American culture. Indeed, Winterthur has been designated as a "Center for Advanced Study" by the National Endowment for the Humanities, which is quite an honor since there are only 10 such nationwide. It conducts three graduate-degree-granting programs in collaboration with the University of Delaware. A two-year program in Early American Culture began in 1952 and annually sends out ten students into the museum world, where a network of graduates is affectionately known as the "Winterthur mafia." A PhD program is also offered in the History of American Civilization.

The work of these students is centered in the adjoining Louise du Pont Crowninshield Research Building (named for Harry's sister, herself a collector of Americana), which houses conservation laboratories, classrooms and the 50,000-volume library, a Mecca for scholars in the field recently come to be known as "material culture"—the touchable remnants of our past, as opposed to the political, ideological or esthetic ones. The museum and the University of Chicago Press jointly publish *Winterthur Portfolio*, a quarterly devoted to studies in this field.

Another academic venture of Winterthur is Conservation of Artistic and Historical Objects, a three-year program also leading to a master's degree from the University of Delaware. Students can major in specific problems of conservation and restoration—oil paintings, say, or wooden objects—while at the same time learning about the hazards that threaten historic objects made of other materials, such as pewter or pottery. In the process, the students and staff have the finest laboratories and equipment at their disposal.

Maple Bedroom is prime example of decorative design and furniture as made in 18th-century Philadelphia.

A perfect sum of its parts

When Shakespeare said "good wine needs no bush," he meant good products seldom need advertising. So it is with Winterthur. Scholarship aside, the lustrous beauty of the collection as a whole is what makes the museum so satisfying. Each room setting seems perfectly balanced, its colors and textiles proportioned to the room's space. In fact, all the layouts are so intimate that you could swear John Dickinson, the influential Colonial statesman, had just risen from the Philadelphia Chippendale sofa—that in fact was his—to retrieve a book from another part of the house.

Winterthur has belonged to the du Pont family since

Kershner Parlor, from Berks County, Pennsylvania, has unusually fine ceiling for a 1755 country house.

Chinese Parlor is an opulent example of Western world's fascination with Chinese decorative arts. The wallpaper, painted in China about 1770, shows scenes of village life; the pattern never repeats itself.

1839. E.I. du Pont de Nemours had founded his black-powder works along Brandywine Creek, northwest of Wilmington, Delaware, in 1802. In its early years the company depended heavily on French investors, and apparently suffered some financial reverses. As a result, James Antoine Bidermann, the son of a principal investor, was dispatched to the new nation in 1814 to look into the firm's books. Bidermann approved of what he found. He married E.I.'s daughter Evelina in 1816 and rose to the top of the family-business tree. In 1837, on his retirement as senior partner of the company, he bought a large tract of land not far from the Brandywine mills and built a Greek Revival home on the site. The mansion was completed in 1839 and named Winterthur after the Bidermann ancestral city in Switzerland.

From residence to museum

Bidermann's son sold Winterthur back into the du Pont family proper in 1865. From 1876 to 1927 it was the home of Colonel Henry Algernon du Pont, Harry's father. A series of major additions over the past three-quarters of a century have engulfed the original residence, but have resulted in a unique kind of museum—one in which period furnishings can be seen in a series of rooms, much as they would have been in the historic homes. Indeed, Harry's family lived there until 1951, when a new home was built for them on the grounds nearby.

Harry du Pont was born in the manor in 1880. Although he was a graduate of Harvard, scholarship was not his forte. Most of his youth was given over to helping Colonel Henry run and develop the estate. He learned how to do everything, even how to milk the cows. He boasted of himself as Winterthur's head gardener and spent his twenties visiting museums and galleries, virtually his only recreation away from home. The surprise is that he began collecting seriously only in 1923, his 43rd year. The further surprise is that for nearly a half-century, until his death in 1969, he personally directed the collecting and scholarly output of Winterthur. In recognition of his life's work, Jacqueline Kennedy asked du Pont to become a consultant on her efforts toward the restoration and period furnishing of the White House.

The major source of information about early American furnishings is contemporary household inventories, laboriously prepared—occasionally room-by-room—in connection with wills and estate settlements. Surprisingly, the bedroom was often the most lavish and attractive of American rooms. It was there that Colonists seemed to do the bulk of their entertaining. The most expensive items in most houses were the textiles, especially the canopy and hangings around the bedstead. These woven goods were almost always imported and took many hands to produce, making them a source of pride. The family's best tea set could also be found in this room, along with more chairs than we usually need in our bedrooms today. The custom of having the neighbors over to the bedroom for tea may appear remarkable today, but it is well documented through Winterthur studies.

Salvaged from 19th-century Shaker community in New Hampshire, furnishings are simple and beautiful.

In essence, that is the reason for Winterthur, according to Nancy E. Richards, the museum's chief curator: "We're here to pore over the physical record of our material culture, learn how it was used, and what it tells us about our past." Indeed, the museum is much more than a font of beautiful but mute objects. In fact, a kind of reverse Gresham's Law prevails. With so much beauty around, the mind goes into a kind of esthetic overload. The visitor begins actively to seek out the unusual, and even the downright ugly, in a desperate search for change.

Still, the rooms are dazzling. And perhaps the grandest of them all is the Port Royal Parlor (pp. 98-99).

Michael Olmert, a graphics designer and writer, contributes frequently to SMITHSONIAN *and is author of the occasional column, "Points of Origin."*

Oriental-looking Americans sign the Declaration of Independence on Chinese platter made for American trade.

Striking period piece is large billiard table from Annapolis, 1790-1800.

Fluorescence spectrometer analyzes the metal content of Colonial tankard.

Lethal silver cockspurs, 1765-1800, decorate a certificate attesting to the skill of their maker.

This parlor was salvaged from a country house built in 1762 on Frankford Creek north of Philadelphia. Its owner, Edward Stiles, named his place after the Bermuda town where he was born. The room itself amounts to a textbook exercise in classical interior architecture. It centers around a pleasing marble-front fireplace, which in turn is surrounded by a wood mantel. But over the mantel, Doric pilasters and an open pediment reign supreme. The whole room is then wreathed by a great modillioned cornice. This is truly an elegant room, one that cries out for the high-style furniture that would have been owned by a gentleman landowner or merchant. Clearly, this was not the abode of a provincial hick. Few homes back in England would have been better fitted out.

Imported yellow damask covers the furniture and is also used for the draperies. The contrast between the bright textiles and the heavy mahogany woods is

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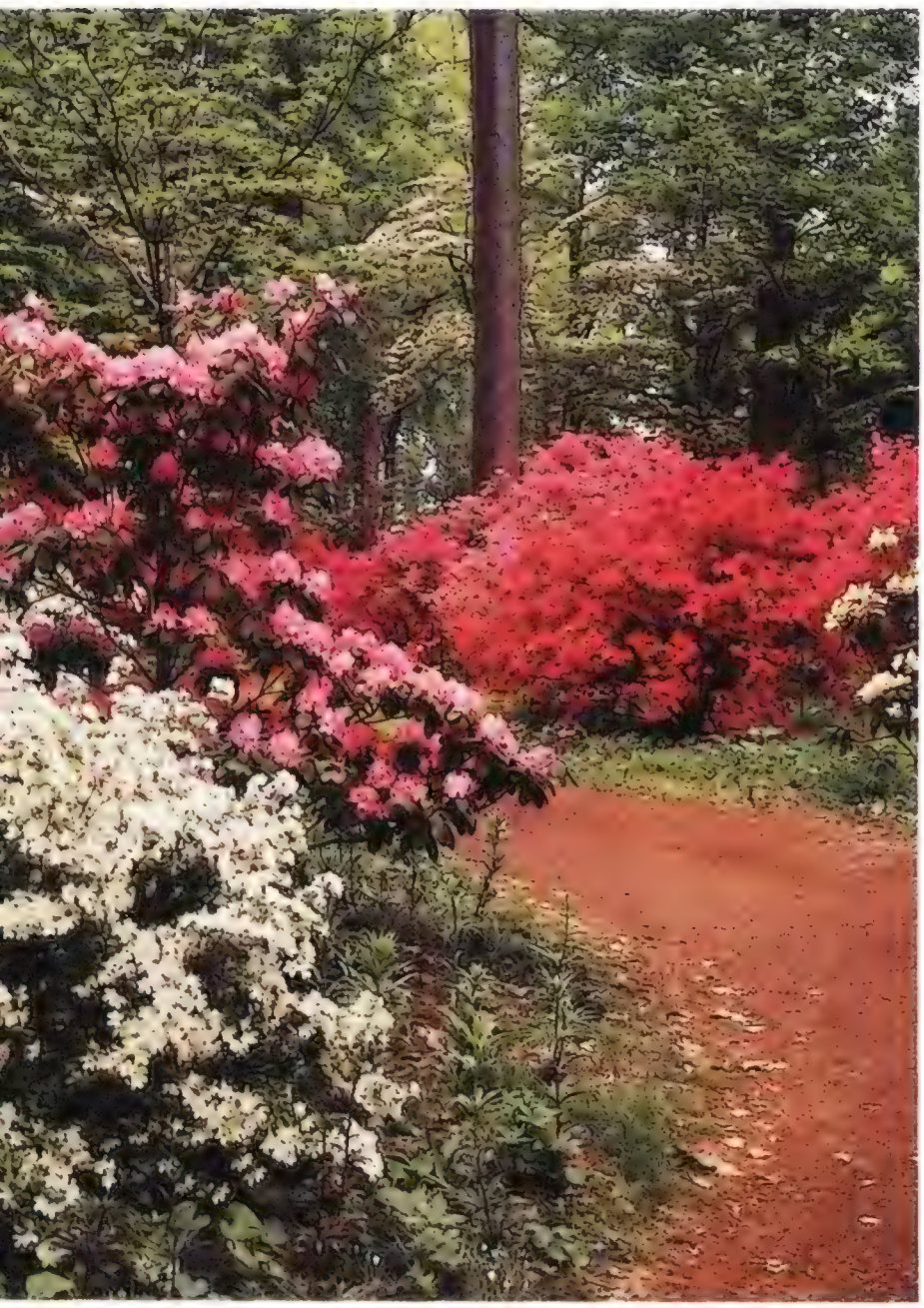
startling. The pair of sofas was once owned by John Dickinson, lawyer, signer of the Articles of Confederation and author of *Letters from a Farmer in Pennsylvania* (1768). Dickinson was also a practicing Quaker. But one look at these sofas is enough to show that something is amiss with the traditional view of Colonial Quaker life as dour and plain.

A notable homestead that had fallen on hard times was Montmorenci, a North Carolina house built near Shocco Springs about 1822 by General William Williams. Its wonder was a freestanding spiral staircase (p. 109), built by a local carpenter, but based on the fashionable "elliptical stairs" as illustrated in Peter Nicholson's *The Carpenter's New Guide*, published in London in 1792. That this example of neoclassical elegance could be plunked down in backwoods Carolina—so far removed from New York, Philadelphia or Charleston—seems indeed miraculous.

Harry du Pont's consuming interest, besides antiques, was gardening, and quite early on he set out to make the Winterthur grounds a dazzling showcase of color throughout the seasons. Something is always in bloom. He styled himself as head gardener of the grounds and supervised a staff that planted and replanted to create carefully planned concentrations of color. For example, the springtime flowering bulbs—daffodils, narcissus—were clustered in irregular patterns along the hillsides, to appear, as he thought of them, as "clouds of color." He was the perfectionist who removed certain azaleas or rhododendrons whose tint of color wasn't quite right. An old hand on the grounds crew remembers his habit of having his men clip sprigs of new azaleas in bloom, place them in Coke bottles, and then move the bottles about in the landscape until he was satisfied with the resulting color and harmony.



Emblazoning giant spreads of pink and white, azaleas glorify Winterthur garden grounds in May.

Wally Petroll, head of the gardens and grounds division, fondly recalls du Pont's dedication to growing things: "He'd drive along the paths in his car and have us shake the branches of individual trees or shrubs. The idea was to settle which ones should be moved or pruned. And we quickly learned not to finish planting a tree until he'd approved of its final resting place. We'd leave the roots in their burlap ball until he returned from a vacation. He once sent me way up to a New Jersey field to get some butterfly weed he thought might look good as ground cover in his meadows. He'd seen it growing wild along the road.

"H.F. just wouldn't take no for an answer. Another assignment was for me to get a cutting from a mimosa tree he particularly admired that was growing in the front yard of a Philadelphia Main Line matron he'd met at some board meeting. Well, I knocked on her door and told her why I'd come, but she flatly refused. I was very young then and was afraid to come back empty-handed, so I did what any ambitious botanist would do. I waited until after dark, sneaked back there and nipped off the tiniest branch. The cutting took root and now is a full-grown member of the grounds."

Metal and concrete to stuff a tree

Old trees were also of special interest to du Pont, who once saved a century-old sycamore by having its rotten core removed by jackhammers and refilled with an I-beam and 17 tons of concrete. It lives today.

The same patience that guided du Pont's gardening went into the displays inside the museum, where the works of great American craftsmen, celebrating the American spirit, are venerated. In a letter written toward the end of his life, he remarked on his method: "Period rooms, which have never been plentiful, were bought as they came on the market, and were reconstructed as nearly as possible in their original form;

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but it has taken all these years to get all the correct furniture and period rooms we needed, and, needless to say, every time a paneled room or mantelpiece was installed, I moved to this room the furniture that best suited it." (This was a heroic act of preservation at a time before there was much interest in the salvaging of old homes.)

Throughout the years, du Pont remained his own man. Although he hired architects, curators and cataloguers to oversee his home/museum, he was always his own buyer. A dealer once asked him who his agent was and got the swift reply: "You're looking at him." He never bought a collection whole, despite his wealth. Instead, he would carefully cull through each and every piece of china and flatware, returning the unwanted items to the dealer.

One of the special touches at Winterthur is that a highly trained guide, flashlight in hand, accompanies every group of four or five visitors through the rooms. In this respect, Winterthur is unlike any other museum. The guides act as representatives of the old Yankee spirit, ready to illuminate dim corners of the past. For example, why is there so much Chinese-export porcelain amid the Colonial furniture? The answer is one of pure economics: both the Chinese and the Colonial merchants made money on this exchange. Winterthur has 5,500 pieces of China-trade ceramics made expressly for the American market, including a platter that depicts the signing of the Declaration of Independence. The underglaze painting on it is amusing: all the Declaration signatories are wearing inscrutable expressions on their obviously Oriental faces (p. 104). Like as not, the unknown painter had simply never seen a Westerner.

Another special feature of the museum is its "touch and discover" room, where school children make their first acquaintance with the past. Recently, I sat in as a group of third-graders pulled at their shoes with bootjacks, played with a toy Jacob's Ladder, and combed and carded wool. They even dressed up in Colonial fashions. But there was shock at the weight of a Colonial flatiron: "Gosh, Benny, feel this. This is heavy!" And admiration for the Yankee ingenuity shown in a glass-peg lamp designed to fit right into a candlestick to burn whale oil. Truly, this is a museum at work, and one that bears out the kudos from Yale University when it awarded du Pont an honorary doctorate in 1953: "You have shown how the judicious and studious collector can instruct the learned and edify the many."

In conservatory of his house, Henry Francis du Pont, at 85, was painted by artist Aaron Shikler in 1965.

Elegant freestanding spiral staircase was modeled on one at Montmorenci, a demolished Southern mansion.

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Inbred Rhino Mouse first develops normal coat;
after two weeks it gradually goes bald and wrinkled.

By Richard Wolkomir

Aristocratic mice are a keystone of genetic study

Scientists at Maine's Jackson Laboratory are studying unusual rodent thoroughbreds that give their research some new wrinkles

At the Jackson Laboratory, in Bar Harbor, Maine, more than 217,000 mouse embryos are traveling into the future. They are frozen in cryogenic tanks kept as cold as −196 degrees C by liquid nitrogen. A century or more hence, scientists will thaw some of these embryos, implant them in foster mothers, and mice of the 1980s will be born in the 21st century.

Scientists have already thawed embryos frozen for eight years and grown them into normal mice. They calculate that embryos could be revived after centuries in the deep freeze.

Why a Frozen Embryo Repository for a creature as common as the mouse? At the Jackson Laboratory, the world's largest center for the study of mammalian genetics, three million mice are born each year. Anything but common, these mice are a precious scientific resource, bearing pedigrees that stretch back as far as 2,000 generations. That is the equivalent, for humans, of 6,000 years. Some of the frozen embryos carry now-extinct gene lines, preserved for future geneticists who may wish to perform experiments that today's scientists cannot conceive.

By tracing the biological legacies that the Laboratory's mice bequeath to their progeny, geneticists probe the secrets of chromosomes. They seek to understand diseases ranging from diabetes to cancer. They investigate aging, obesity, birth defects and neurological disorders. They study the transplantation of organs. And they explore the immune system, our inner defenses against invading microbes.

Most of this research is based on *Mus musculus*, the common house mouse. Like tiny zoological factories, the mice pass on genes for the scientists to contemplate. And they do it quickly: mice are physiologically similar to humans, contracting many of the same diseases, but their life-spans are much shorter; everything happens 30 times faster than in humans. The Jackson mice all have well-documented chromosomes, making them ideal tools for geneticists. To accomplish this, Jackson's rodents are inbred—siblings are mated with each other to produce pure lines of distinctive, uniform character. As a result, the Jackson mice range from mildly eccentric to profoundly odd.

There is, for instance, Streaker, a hairless exhibitionist that parades about in the pink altogether. And there is Waltzer (p. 117), one of many mice named for behavioral peculiarities, like Bouncy, Dancer, Fidget, Jackson Circler and Hot Foot. By observing the results of crosses between mice from such strains, in which each individual is a genetic carbon copy of all the others, scientists can trace the effects of single genes. That would be impossible with humans and ordinary animals because of their enormous genetic diversity—the effects of any one gene would be drowned out in all the "static." On the other hand, after 20 successive brother-sister matings, Jackson mice's genes are 99.999 percent identical to those of their siblings. Genetically, one Wabbler, Whirler, Waddler, Twitcher, Twirler or Trembler is a mirror image of any other.

Some Jackson mice share human disorders, from diabetes to muscular dystrophy, making them tools for medical research. For instance, Jackson boasts an Anemic Mouse (p. 117) and Dwarf Mouse (p. 117) as well as an Obese Mouse. Mice with such names as Jerker, Jittery, Shaker, Lurcher or Oscillator have in-

Photographs by Richard Howard

Born hairless and with eyes covered by skin, all mice begin life like this one-day-old Jackson specimen.

herited defects, mainly in their nervous systems. By tracing the defective genes in the mice, researchers can study how the genes do their work, information that they can then apply to human beings.

Jackson mice have coats of many colors, although there is also a Balding Mouse, a Moth-Eaten Mouse, and another—hairless and incredibly wrinkled—is called Rhino (pp. 112-13). Few outsiders ever enter the Laboratory's sprawling Mouse House, where these strange mice, in their squeaking thousands, live and breed until needed by Jackson scientists and other researchers in 30 countries. In fact, if the mice were specimens brought back from Jupiter, their safety could not be more painstakingly maintained.

Entering the Morrell Park Laboratory, a separate building where the majority of Jackson mice live, is an exercise in fastidiousness. Visitors must first scrub down like surgeons, change from street clothes to sanitized coveralls and don shoe covers. Everything entering this shrine to mousedom—feed, bedding, cardboard boxes, wire—must first be sterilized. To make doubly sure that no invidious microbes enter the inner sanctum, air pressure inside is slightly elevated, so that the air always flows *out* from the mouse quarters, never in.

During a blizzard, the mice come first

"In a way, this is a specialized agricultural operation, and the crop is mice," says Dr. Edwin P. Les, a geneticist, who is assistant director of animal care and husbandry at the Laboratory. He points out that the world's largest center for mammalian genetics research is also the world's largest supplier of genetically defined mice. At any moment some 600,000 mice are living here.

To the Laboratory's workers, protecting mice is of prime importance. That dedication was tested not long ago when the worst blizzard in decades snapped power lines all across Mt. Desert Island. At 1 A.M. telephones began ringing in the homes of Jackson maintenance workers; the Laboratory's power was out and the mice were in danger. For 34 straight hours crews nursed the drifted-in Laboratory's emergency generators and tended to the 600,000 sensitive rodents. One man's wife sent the workers tureens of corn chowder and stacks of peanut butter sandwiches. Meanwhile, in their precisely heated and humidified cages, Jackson's quadrupedal aristocrats squeaked imperiously for their own specially formulated chow.

If the Laboratory sometimes seems as much a dedicated extended family as a large research center, with 25 buildings on 73 acres, and an annual operating budget of about $14 million, that is precisely how it was conceived. The Laboratory is located in isolated

Mice culled from the Lab's colonies because they look "different" are potential source of new mutations.

Bar Harbor, far to the north of the bastions of "big science." In a way, the Laboratory was founded as a gesture of defiance to bureaucratized research. It has the free-wheeling flair of 19th-century science, when researchers rode off on their separate quests unhobbled by departmental politics.

Geneticist Clarence Cook Little, the Laboratory's founder, insisted that there is a connection between genes and cancer, and he crusaded to make inbred mice the geneticist's chief tool. But he also heartily loathed institutional constraints. And he had the charismatic qualities required to do something about it.

He had raised mice as a child in suburban Boston. And, as a Harvard junior in 1909, he published his first scientific paper, "The peculiar inheritance of pink eyes among colored mice." After stints in research and administration at Harvard and the Cold Spring Harbor Laboratory on Long Island, the 33-year-old Little became president of the University of Maine—a young president and a fierce one: after feuding with Maine's governor, he stomped off to assume the presidency of the University of Michigan, where the official history refers to his tenure as a "stormy term," calling him "brilliant but tactless."

Yet, for many summers Little had been leading students to Maine's Mt. Desert Island for a taste of research. And, in 1929, he was sufficiently tactful to convince the hard-nosed tycoons inhabiting Bar Harbor's million-dollar "cottages" to fund an independent research laboratory—free of all academic entanglements—in the exclusive resort. The new laboratory was named for one of those benefactors, Hudson motorcar magnate Roscoe B. Jackson.

It was a stuffy Victorian enclave into which Little introduced his mice. The new laboratory, on the other hand, was faintly raffish. One early staff member, Dr. George Snell, remembers that scientists took turns using the Laboratory's two microscopes. In the nearby woods were groups of tents, accommodations for Jackson's high school and college summer interns. Over the years, many have gone on to distinguished scientific careers; two of them, MIT microbiologist David Baltimore and University of Michigan molecular biologist Howard Temin, have won Nobel Prizes.

This rustic hodgepodge, isolated on a Down East island, quickly generated major discoveries. The explanation may have been in a note the secretary made on July 8, 1930, at the first staff meeting: "We should adopt the system of telling one another everything we are trying to do."

It was virtually a commune. During the Depression, when funding dried to a trickle, the Laboratory's scientists voted themselves pay cuts up to $100 per month so that the mice could eat. To fill the communal larder, they gardened and fished the Atlantic. Everyone rallied around Little, who was called "Prexy." As

Black-and-white spotted coat marks this mouse as Piebald; hair color is a common trait used for selection.

one longtime animal caretaker puts it: "We always knew Prexy would come up with some money when we had to have it." Somehow he usually managed. The subsequent infusion of dollars allowed the staff to devote more time to science and the making of important research advances.

It was Jackson researchers who, during the 1930s, first demonstrated that several genes control the body's acceptance or rejection of transplanted organs. Jackson scientists also discovered that something in the milk of certain mouse strains leads to cancer—a discovery that stimulated new research on the virus theory of malignancy. During the 1940s, Dr. George Snell identified the particular "histocompatibility" genes that determine whether the body will accept tissue grafts, the work that earned him a Nobel Prize in 1980.

Then, in 1947, disaster struck. Much of Mt. Desert Island caught fire. For several days the fire stayed at a distance from the Laboratory, until a sudden change in the direction of the 50-mph winds sent forest fires roaring toward it. When the alarm came, scientists and assistants had time only to grab whatever papers and paraphernalia they could and run.

Later, when they returned, everything was gone, including the breeding stock of 60,000 unique inbred mice. The scientists and workers huddled around Prexy while he surveyed the skeletal walls that had been the Laboratory. The surrounding groves he had so admired, allowing no tree to be cut, were ashes. Little squinted out over the charred hills to Frenchman's Bay and said enthusiastically: "Now we can see the sea!"

In a certain sense the fire turned out to be a blessing for the Laboratory. The devastation focused international attention on the research center and the importance of its work. From across the country, donations came pouring in to rebuild the facility. But some of the most valued donations had four legs: when news of the fire spread, scientists around the world began sending back their Jackson mice so that the Laboratory could rebuild its breeding stocks. Phoenixlike, the Laboratory rose from the ashes, much larger and far better equipped than before.

"Each time the Laboratory has grown, I've worried it would lose its character," says George Snell, for whom Jackson's newest wing is named. The Laboratory has indeed grown, from 15 employees in the beginning to approximately 500 today. The science has changed radically, too. "Today the importance of sophisticated equipment is fantastic, and techniques like genetic engineering have totally altered the picture," Snell adds.

Yet, the Laboratory retains its freewheeling flair. "It's a charming place to do science, because interaction between groups is so easy here," says Dr. Elizabeth (Tibby) Russell, one of the earliest scientists on the staff. As an example, she cites a young couple, Nancy Jenkins and Neal Copeland, who recently came to Jackson to study leukemia viruses. Molecular geneticists skilled in genetic engineering, they were drawn to

Richard Wolkomir, a regular contributor, wrote on education of entrepreneurs in the January 1983 issue.

Waltzer (shown circling in multiple exposure) is mutant known to Far Eastern breeders for centuries.

Bar Harbor by the Laboratory's wealth of mutant mice. At many research centers, the arrival of two peppy young scientists, brandishing a glittering new technique and eager to rearrange "invisible" chromosomes, might induce considerable interpersonal frost. After all, as George Snell points out, "Initially, practically any genetics you could get your teeth into had to do with these things you could see." That was because genes might be linked. For example, the gene for a tawny coat and the gene for a certain nervous disorder might always appear together. Any tawny mouse also would have the nervous-disorder gene, giving geneticists a visible marker.

"In the early days," explains Snell, "you could prove new things simply by making crosses with the mice." The crosses were by no means guesswork matings between different strains of mice, however, as the work of this persistent man bears out. To prove the existence of, and identify, the histocompatibility genes, he developed several dozen lines of transplant-resistant mice, each requiring 12 to 14 generations of breeding and testing.

When Jenkins and Copeland arrived in hot pursuit of their leukemia virus, Tibby Russell made available to the newcomers her experience and her own colony of mutant mice, painstakingly maintained for decades. And other senior scientists traded them instruction in

Albino Anemic Mouse and its healthy black litter mate are paired for investigations of anemia at Laboratory.

The distinctive coat color of this mouse is the result of three mutant genes: Himalayan, angora and satin.

A contrasting pair, Dwarf Mouse and its normal litter mate are used in study of dwarfism and growth.

Stack of storage boxes in one of Lab's cryogenic crypts contains mouse embryos frozen for posterity.

This mouse was born from an embryo that was frozen for 39 months, thawed and implanted in a female.

mammalian genetics for insights into genetic-engineering techniques.

Now Jenkins and Copeland are energetically poking and prodding mouse DNA, using techniques available only in the past few years. "Geneticists here have been developing, preserving and working with these strains of mice for years," says Jenkins. "Now we, too, can go to work."

Other Jackson scientists continue to advance science through their research and by painstakingly developing and maintaining the invaluable animal models. Out of this exacting process could come hope for victims of many different disorders.

For instance, senior scientist Douglas Coleman, a leading investigator in diabetes research, studies how genes control the body's metabolism. And his chief assistant is a mutant mouse predestined to be fat. It is called, appropriately, Obese Mouse (p. 121). So efficient is its metabolism that it fattens on the same rations that keep normal mice lean. "It was this mouse that got me thinking about diabetes," says Coleman, an intense man tanned from frequent sailing off the Maine coast, who believes that diabetes may once have been a useful mutation.

For wild animals and primitive peoples, periods of plenty frequently are brief respites in long stretches of famine, he says. Would not individuals efficient at storing calories during the plentiful periods have the best chance of surviving lean times? Coleman notes that, deprived of food, obese mice survive eight times longer than normal mice. And he says that when primitive peoples become acculturated and food becomes abundant, soaring rates of diabetes, which is associated with obesity, are often seen. He cites the Pima Indians of the Southwest, who are virtually all obese, with diabetes afflicting 50 percent.

The mice with which Coleman works differ from one another by no more than a single gene. "Because the genetic makeup of these mice is precisely known, we can learn many things about the workings of a particular gene," he says. One of his discoveries shows that, at least in mice, several genes can cause diabetes; the disease may be more than a single disorder.

Recently he found that a substance called DHEA (short for dehydroepliandrosterone) produced by the adrenal glands can control diabetes in mice. This weak male sex hormone has no known function in humans, although our adrenal glands produce it in quantity.

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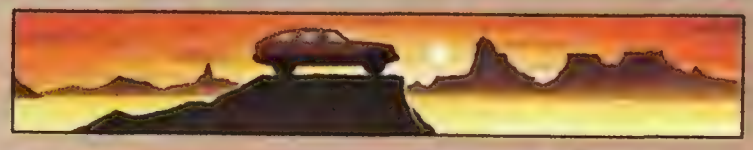
FOR THE WHITE

FOR THE WINDING

FOR THE WILD



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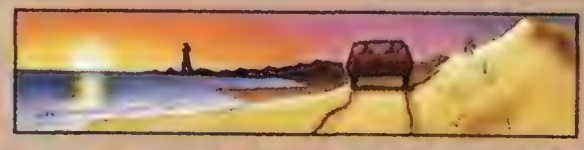

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Courtesy of The Jackson Laboratory

Laboratory's founder, Clarence Cook Little, was a visionary who made mouse a standard genetic tool.

When Coleman fed DHEA to diabetic mice, their blood sugar stayed normal as long as he continued administering the substance. His current work with DHEA continues to produce significant results.

Ever since the days when Prexy camped summers on Mt. Desert's rocky hillsides with his biology students, the outdoor life has been almost as much a part of the Laboratory as microscopes and chromosome charts. Senior scientist Andrew Kandutsch, for instance, is building a log cabin, pioneer fashion. He and his wife cut and peel the cedar logs themselves. And looking out over Strawberry Hill and the islands of Frenchman's Bay from his third-floor office at the Laboratory, he likes to watch bald eagles soar over the Atlantic.

But Kandutsch's chief interest is neither primitive architecture nor ornithology. He is a leading expert on cholesterol, the substance that many researchers believe is one of the culprits behind heart disease. Yet, without cholesterol we would die. Our cells manufacture this concatenation of carbon, hydrogen and oxygen molecules in a stunningly complex chain of chemical reactions. "It involves processes that even now can amaze scientists," he says. And he points out that, if the cholesterol assembly line were to break down, our cells could no longer function, since cholesterol is a key component of each cell's plasma membrane, its outer wall.

The membrane, according to Kandutsch, "has a consistency something like chicken fat." Cholesterol helps fine-tune the membrane's viscosity—in some areas the membrane is more fluid, in others it is more solid—which regulates the passage of substances into and out of the cell. "We can show regulation effects in the test tube, but we're not yet sure how it works in animals," he says.

Ten years ago Kandutsch found that certain substances manufactured by our bodies stop cells from producing cholesterol. Someday, by giving physicians control over the amount of cholesterol in our systems, that discovery may lead to a potent new treatment for heart disease. For now, though, he is using this chemical "switch" to turn cholesterol production on or off, thus studying cholesterol's role in the life of a cell. And he is finding that cholesterol has no mere walk-on part.

"We found that, when it is going to divide, a cell makes cholesterol, then it makes DNA, and then it divides; when we stopped cholesterol production, the cell produced no DNA," Kandutsch says. "Personally, I think we cannot understand cancer because we don't understand the various stages in the cell cycle." Understanding how cells regulate themselves is the underlying aim of his research. "That is what is interesting about biological science, how all this gets managed," he says. "The whole thing is so damned smart, somehow." And he adds: "It's an amazingly complex business—it's like trying to figure out the Universe."

Jackson scientists have captured on motion picture film something of that awe underlying their work. They have filmed a living cell from one of the Laboratory's thousands of mice. Floating at the cell's center, the chromosomes—a tangle of worms—suddenly begin to wriggle. Abruptly, they divide into two teams and rush to the cell's opposite sides. Then the cell splits, becoming two separate cells.

It may be the planet's most humdrum miracle, endlessly iterated in all living things. Yet, what controls this biological abracadabra nobody knows. It is this mysterious realm inside our cells, the microscopic kingdom of the chromosomes, that Jackson scientists explore, helped by their small squeaking colleagues.

As Walt Whitman once put it, in words that could be the Jackson Laboratory's motto: "A mouse is miracle enough to stagger sextillions of infidels."

Obese Mouse, two-and-one-half times heavier than normal relatives, may hold clues to obesity in humans.

Nils Strindberg photographed *Eagle* just after it was forced down. Film was developed 33 years later.

By R. T. Kahn

A Swedish film re-creates a daring flight that failed

In 1897 three explorers disappeared trying to reach the North Pole by balloon; diaries and film found years later reveal their story

A gas-filled balloon named *Ornen* (*Eagle*) lifted off its moorings at the Swedish coastal settlement of Hovs Hallar, rose to a height of 250 feet, and slowly drifted northward over the North Sea. Clinging to the gondola's ropes were a tenacious international film star and two supporting actors, while a cinematographer photographed the airborne action. The film star was Max von Sydow; his fellow players were Göran Stangertz and Sverre Anker Ousdal. The director, watching anxiously below, was Jan Troell, best known in this country for his direction of *The Emigrants* (1972) and *The New Land* (1973), the first of which starred Liv Ullmann and won four Academy Award nominations and received worldwide acclaim.

It was a tense moment. At stake were not only the safety of the three actors aloft, but a tight production schedule and the budget of what is the most expensive movie (nearly $3 million) ever made in Sweden. *The Flight of the Eagle* is based on Per Olof Sundman's novel about an ill-fated polar expedition that, because of its enigmatic conclusion, came to be known as the "Andrée riddle." Like Troell's earlier film, it was

Here, scene opposite is being re-created for the movie, in which many of Strindberg's pictures are duplicated.

nominated for an Academy Award (this time in the best foreign-language-film category), and will soon be seen in major cities in the United States and Canada.

It is the true story of Salomon August Andrée (portrayed by von Sydow) and his two companions, Nils Strindberg and Knut Fraenkel, who attempted to fly over the North Pole in a balloon. They took off from Danes Island in the Spitsbergen archipelago (now called Svalbard) on July 11, 1897, and three days later came down in the frozen wastes 298 miles away. For nearly three months Andrée and his colleagues trudged in a zigzag route across the ice, losing all sense of direction as the floes heaved and shifted treacherously around them.

On July 15 the captain of a Norwegian fishing vessel shot down a carrier pigeon. In the capsule fastened to the bird was a letter from Andrée dated two days earlier. In 1899, and again in 1900, buoys with messages in them were picked up out of the sea. Aside from these brief communications, all three optimistic or at least noncommittal, silence had closed in. No further trace of the three men was found.

Not, that is, until some 33 years later, when the crew of a Norwegian sealer went ashore on seldom-visited White Island, and found the remains of Andrée's last camp. It was approximately 245 miles from the men's takeoff point and 205 miles from where their balloon came down. Found at the site, besides their bodies, were Andrée's remarkably detailed diary of the expedition and photographer Strindberg's exposed film. When it was developed after all those years in the snow, the activities and tribulations of the long-lost trio sprang miraculously to life. Their bodies were brought back to Sweden and borne through the streets of Stockholm (p. 136). Salomon August Andrée became a national hero, since success is not necessarily the gauge of valor.

Jan Troell had always been fascinated by Andrée, by his moral dilemma. "There is a theory," he says, "that he recognized shortly before the takeoff that, with the

R. T. Kahn is an American photojournalist. His interest in the "Andrée riddle" dates back to the late 1970s, when he was living in Sweden.

Fraenkel, 27, had a robust physique and lively appetite for adventure.

Andrée, 43, was characterized by indomitable courage and a strong will.

Photographer Strindberg was, at 25, the youngest member of the party.

resources at his command, his expedition was doomed." Troell was intrigued, too, by Andrée's meticulous attention to certain practical details: "He even designed the tent, and the clothes he and his companions wore. All three knew what they were letting themselves in for, but refused to admit it." So, in the end, it was the men themselves that mattered most to Troell and led him to make his film.

What kind of men were these who launched themselves onto a course almost certain to lead to tragedy, and what was the spirit of the times that contributed to it?

It was a period when international scientific enterprises were being organized, many aimed at meteorological and physical investigation of the north and south polar regions.

Most of these expeditions were well-equipped and had plenty of knowledge to go on. In 1893 the great Norwegian explorer Fridtjof Nansen sailed from Christiania in his specially designed ship, the *Fram (Forward)*, to test the direction of polar currents. The ship froze fast in the ice, as Nansen had intended, and he and a lieutenant left it to proceed by dog sled and kayak. They reached Norway safely and so did the *Fram* and her crew. Nansen was hailed throughout the world.

Frederick George Jackson and Alfred Harmsworth (Lord Northcliffe) explored the region from 1894 to 1897. Commodore Robert E. Peary led expeditions to the North Pole in 1898, 1905 and 1908, and nearly lost his life in the process.

In the lift-off scene from the film, von Sydow, right, plays Andrée.

But Andrée was the first to attempt to fly over the Pole in a balloon, if not the first to suggest it. Some 20 years before, Henry Coxwell—an English dentist and, later, an officer in the German balloon corps—had published detailed plans for possible polar trips by balloon, but apparently Andrée had never seen them.

The idea of ballooning over the North Pole may have taken shape in Andrée's mind while he was in Spitsbergen in 1882 with a Swedish scientific team led by Nils Ekholm. He came back convinced that polar exploration was a task for the Swedes. "The Swedes are noted for their dauntless courage," he said. "They are familiar with long winters and severe cold, and they are better suited than others to solve the riddle of the Polar Basin. The North Pole is a Swedish affair."

This patriotic, intelligent, strong-willed man—Salomon August Andrée—was born in 1854 in Gränna, Sweden. He was brought up in a home atmosphere—severe by today's standards—that stressed obedience and punctuality. There was no coddling or indulgence. He was a good student. At the end of one high school term he won so many prizes that a

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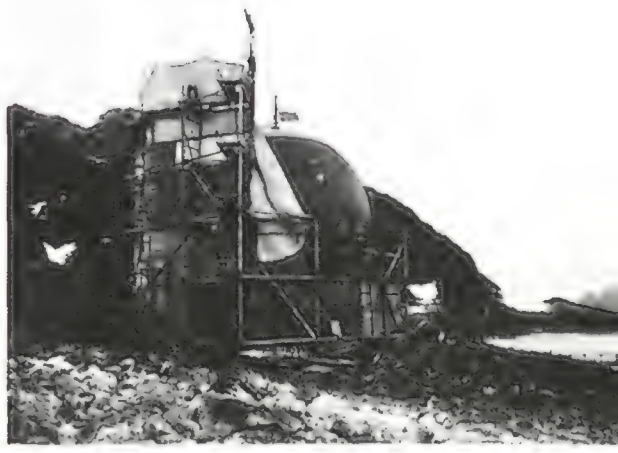

July 11, 1897: The *Eagle* is filling with gas within the balloon house.

man in the audience said to his neighbor: "That lad will wear out a pair of soles going up to receive his prizes." Said the neighbor: "He may, if he likes, for he is *my* son!" He also did well at the State Technical University.

Andrée never married, there apparently being no place in his single-minded pursuits for the demands of a wife. The only woman who played an important part in his life was his mother, with whom he maintained a tender, almost abnormally devoted relationship.

Two years after he graduated from the university, Andrée went to America. In Philadelphia the 1876 Centennial Exposition was in full swing. He called on the Swedish consul-general to ask for a pass, but was offered a job as a janitor in the Swedish exhibit instead. Later in life, whenever he saw a street sweeper, he would say: "I learned that art when I handled a birch broom in Philadelphia."

Andrée was already interested in aeronautics. In Philadelphia he met the well-known aeronaut John Wise, who taught him the fundamentals of ballooning. But then he became seriously ill (from drinking ice water, he thought) and returned home.

Back in Sweden he went to work in the Royal Patent Office in Stockholm and eventually rose in the ranks to chief engineer. But that was a livelihood, not a career—for which he continued to prepare with exhaustive studies of ballooning and aeronau-

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Balloon is now in the air. Film carefully reconstructs every detail.

tics. In 1893 the Lars Hierta Foundation gave him a grant for the purchase of a balloon, which he bought from a French aeronaut and christened *Svea*. He made nine ascents in the *Svea*, all of them solo, and decided that for scientific observations there should be at least two persons in the gondola, and better yet three.

In 1894 Andrée was approached by the scientist and explorer Baron Adolf Erik Nordenskiöld, who raised the question of using captive balloons for making observations on Arctic expeditions. Andrée then told him about his idea of reaching the North Pole in a free balloon. Nordenskiöld said, "Well, that does not sound at all bad." Thus was born the Andrée expedition.

But where were the funds to come from? At this point Andrée received a call from Alfred Nobel, the inventor of dynamite and later founder of the Nobel Prizes. He had read about Andrée's project and wanted to contribute some money—£1,100. A week later he increased it to £3,600, or half the cost. Andrée then applied to King Oscar II and got £1,660. Others came forward, and within three weeks the necessary funds were at hand.

A balloon was ordered from H. Lachambre of Paris and Andrée put together his team. It included Nils Ekholm, with whom Andrée had gone to Spitsbergen 14 years before, and Nils Strindberg, a physicist, photographer and relative of the playwright

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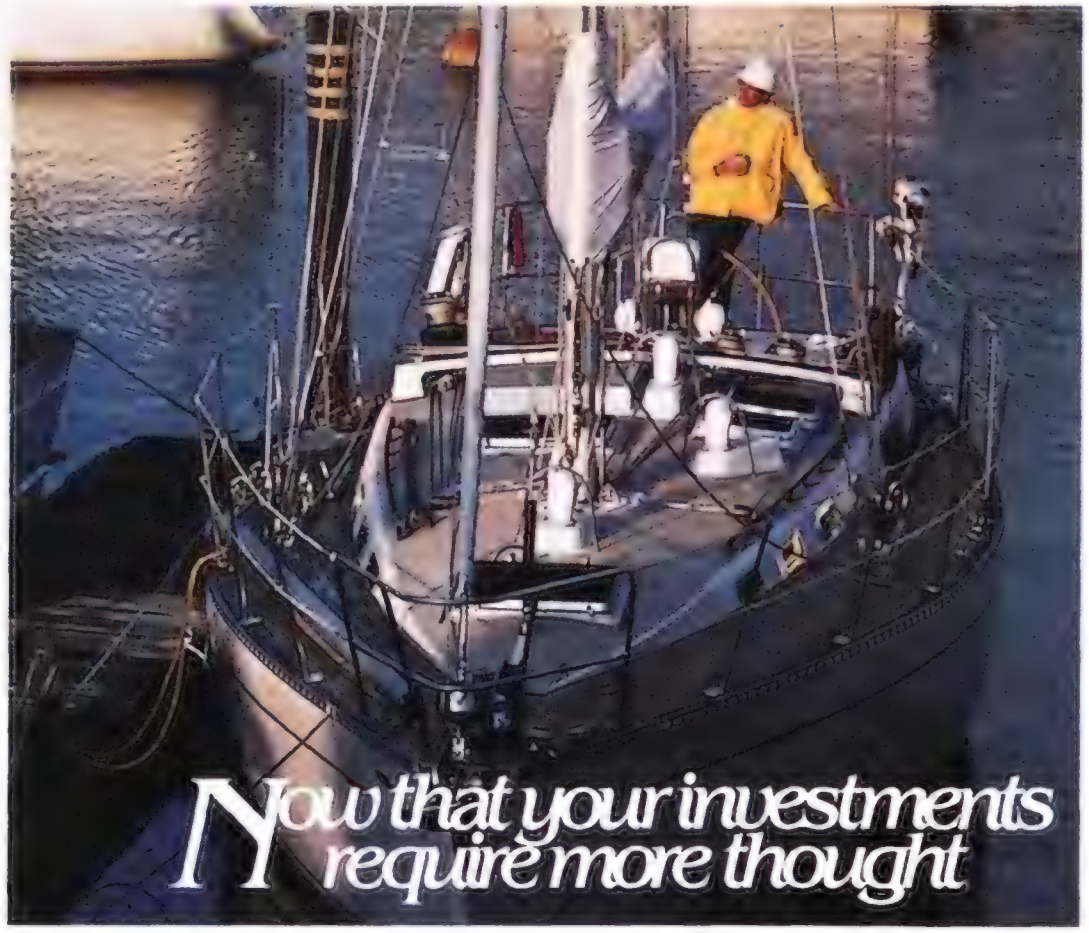

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The *Eagle* in flight, heading northward, taken by a member of the ground crew.

August Strindberg. Also in the party that sailed from Gothenburg on June 7, 1896, were Lachambre and two carpenters who were to build a house to protect the balloon (pp. 126, 127) while it was being filled with gas. They arrived at Danes Island, Spitsbergen, on June 22.

The balloon house was built and by the beginning of August all seemed ready for the ascent. Andrée wrote in his journal: "Everything has turned out exceedingly well and according to our wishes, so that, if Nature will only do its share, the matter would soon be clear." But it was not to be; Andrée's first attempt to realize his dream had to be aborted. The reasons were clear. The expedition started out too late; although only August, the weather in Spitsbergen was already wintry. More important, there never was a favorable wind.

The following year, on May 18, the party set out again, but without Ekholm, who had resigned because he had little faith in the expedition's success. He was replaced by Knut Fraenkel, a military man, sportsman, engineer and balloon enthusiast. A 280-ton gunboat had been placed at the disposal of the expedition by King Oscar II. The *Svenskund* was solidly built and could cut a clean passage through the ice. However, the pre-

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Fraenkel and Strindberg pose with polar bear Andrée shot, probably on July 19.

vailing attitude among the cynics, Ekholm included, was that success would be measured not by reaching the North Pole but by getting oneself safely home again.

Andrée brought enough provisions to last for four months. It was calculated that the balloon would carry enough ballast for 30 to 35 days. By sacrificing some of the equipment, they could increase the length of the voyage by an additional 20 days. If they should be forced down, they would have to return on foot across the treacherous ice field.

On arriving once again in Spitsbergen, they found that the balloon house had survived the winter. They set to work at once on testing the balloon, which was inflated and deflated many times, and on calculating the hydrogen's longevity. But unfavorable wind and weather kept them waiting until July 11, when Andrée gave the go-ahead signal. They said goodbye to the *Svenskund* crew. Suddenly Andrée snatched himself away from the embraces of his friends, took his place in the gondola, and called out in a firm voice: "Strindberg . . . Fraenkel . . . Are you ready to go?"

Sandbags were thrown overboard, lines were cut, the balloon house was taken apart, there was a sudden jerk and the *Eagle* rose sharply for about 165 feet. They were off (p. 124).

Something went wrong almost at once. The lower two-thirds of the draglines, which were to trail on the ground and keep the balloon at a height of 500 to 660 feet, fell off when connecting links came unfastened. Without this ballast, the *Eagle* lifted higher and higher over the ice-covered mountains. Ahead lay fog, dampness, ice, the unknown—and no sure means of steering the balloon.

Still, they experienced moments of euphoria. On July 12 Andrée wrote expansively in his diary: "It is not a little strange to be floating here above the Polar Sea. To be the first that have floated here in a balloon. How soon, I wonder, shall we have successors? Shall we be thought mad or will our example be followed? I cannot deny but that all three of us are dominated by a feeling of pride. We think we can well face death, having done what we have done. Is not the whole, perhaps, the expression of an extremely strong sense of individuality which cannot bear the thought of living and dying like a man in the ranks, forgotten by coming generations? Is this ambition?"

By July 14 they had flown 65 hours in a generally northerly direction and were about two-thirds of the distance to the North Pole. An astonishing amount of moisture had settled on everything and was turning to hoarfrost. The gas cooled and the balloon sank lower and lower. They agreed they could not go on. And so, on the

Film version of same scene includes Andrée, who takes photograph above.

The people who do the job are usually the ones best equipped to improve it. That's why, in 68 plants across the country, over 1,100 Employee Involvement Groups have been established by Ford Motor Company and the UAW. Their goal? To build the highest quality cars and trucks in the world. Members of this Group, at the Lima, Ohio, Engine Assembly Plant, tore down and individually reviewed one hundred brand-new High Swirl Combustion engines —before the Company went into full production on this new engine design. Their zeal in fine-tuning their own work resulted in a better-fitting piston-ring assembly that will lead to a better-performing engine. And that's only one of 45 ideas that Employee Involvement Groups contributed toward increasing the quality of this new engine. Employees speaking and management listening. Another reason Ford Motor Company achieved the highest quality rating of any major American car or truck maker. A fact based on a national survey measuring things gone wrong, after 3 months of ownership, conducted among 11,000 people owning Ford and competitive 1982 new vehicles.

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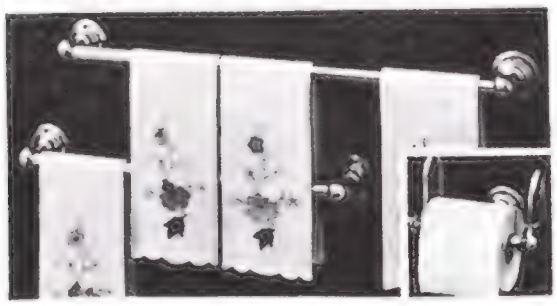

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The three men with their upturned boat—a "delayed-action" photograph.

fourth day of their flight, Andrée opened the valves and allowed the *Eagle* to drop slowly to the frozen wastes below (pp. 122, 123).

On the ground, with no hope of regaining flight, the trio concluded that it was better to wander across the ice in an attempt to reach Franz Josef Land, 227 miles to the southeast of them, where a cache of emergency supplies had been left. They spent a week preparing themselves for the journey across the ice, unloading their supplies from the *Eagle* and reloading them on the sledges they had brought with them.

The next months, until they finally reached White Island, were ones of almost unendurable hardships, with freezing temperatures, rain, intense wind, fog, drifting floes and the continual drudgery of hauling the sledges over the ice. The monotony was broken when Andrée shot a polar bear and they enjoyed a respite with fresh meat. Andrée captured the moment (p. 130) with Strindberg and Fraenkel posing beside the bear.

They shot more bears. Andrée wrote in his diary that "bear-tracks were seen today, and the day before yesterday two such traces were observed. This means for us that we have wandering butchers' shops around us." Fraenkel became ill, complained of stomach cramps and suffered from severe diarrhea. Andrée relieved his pain with a dose of opium and morphine. He, too, had diarrhea, "but I imagine I am well again now without any medicine."

They made a camp on an ice floe and drifted with it until the floe broke up. By now they were in sight of White Island, an ice-capped slab of rock some 50 miles east of Spitsbergen, and they went ashore on October 5, 1897, to make camp. Here they planned to wait out the winter, but Andrée's diary comes to an end and there is no way of knowing what happened next. During the next few years relief expeditions were sent out, but nothing was ever found.

In the summer of 1930 a small Norwegian scientific expedition, led by Dr. Gunnar Horn, was in the Arctic Ocean east of Spitsbergen. They were traveling aboard a sealing vessel, the *Bratvaag*, so that it was a combined scientific-commercial enterprise. Off White Island a herd of walruses was spotted and two parties were sent out in small boats to hunt them. A

In this scene from the movie, Andrée (foreground) fishes through the ice.

couple of the animals were shot and pulled up on shore to be skinned. After an hour or so, two young men went inland to look for drinking water. Beside a small stream they found a canvas boat, partially buried in the snow. It was loaded with equipment, many of the objects being marked "Andrée's pol. exp. 1896" (the year of the first expedition).

They had found Andrée's last camp (p. 134).

Three skeletons were discovered and identified from initials in their clothing. They were carried aboard the *Bratvaag* and taken back to the Norwegian port of Tromsö, from which so many Arctic expeditions had set out.

Dr. Horn perhaps underestimated the interest the world would take in the find. The little northern Norwegian town was besieged by journalists. The *Svenskund*, the gunboat that had taken Andrée and his team to Danes Island in 1897, was refitted and sent to Tromsö to bring back the remains of the three men. At Gothenburg they were welcomed home to Swedish soil. The *Svenskund* was escorted into the harbor by an enormous fleet of fishing boats; church bells tolled, thousands of torches and flares were lit, and 125,000 people lined the quays.

A wave of enthusiasm and hero worship hit not only Sweden and Scandinavia but the entire Western world. Newspapers everywhere closely followed the progress of events and joined in the chorus of homage. When Strindberg's exposed film was successfully developed, the *New York Times* noted: "No more remarkable photographs can ever have been restored from death to life," and added that they inspired "awe and fear."

But the riddle remained. After a long and painful trek the three men had gone ashore on White Island and made a camp. There, shortly afterward, they died. Why? How?

It was evident that Strindberg had died first. His body was found in a crevice between two rocks, covered with a pile of stones—obviously buried by his companions.

Andrée and Fraenkel had died lying side by side in the tent, as neither of them had tried to remove or bury the other's body. Andrée had Lapp boots on his feet, Fraenkel only socks.

Had they died of starvation? Probably not. Unopened boxes of provi-

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With Strindberg dead, Fraenkel (right—Ousdal) comforts Andrée (von Sydow).

sions were found in the camp. And they must have had plenty of meat: bear bones were lying about, some of them sawed into pieces, and two seal skeletons, also divided by a saw. With their three guns and a revolver they could always have got more.

Had they died of exposure? This is more likely. Professor Nils Lithberg studied the contents of the camp and the lists of equipment, and decided that the quality of their clothing was not up to the demands of a prolonged stay in the Arctic. Furthermore, the three men had only one sleeping bag among them. Aside from the inconvenience, the psychic effect of having to share the same sleeping bag night

One of the expedition's sledges as it was found by the *Bratvaag*, 1930.

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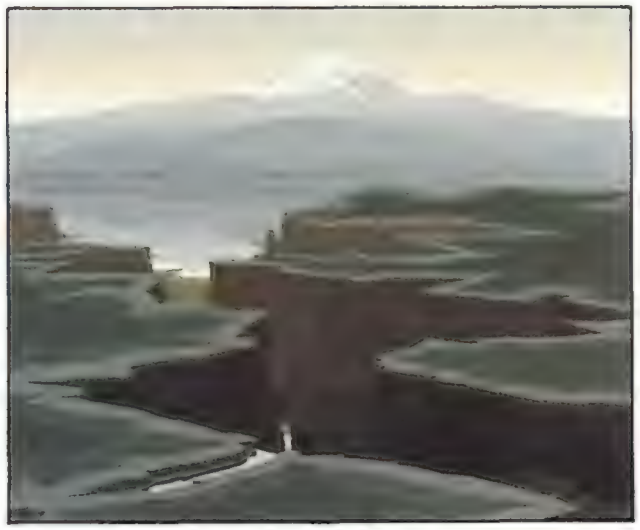

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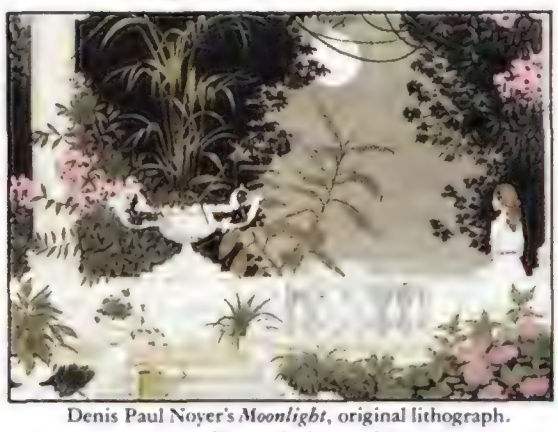

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after night in their desperate conditions must have been considerable—especially when one of them was ill.

It has been suggested that Andrée and Fraenkel in their despair may have committed suicide by taking an overdose of morphine, with which they were supplied. But there is no proof of that, either.

Some maintained that Strindberg died as a result of an accident, and that the other two died from a lack of oxygen in the tent. This theory, too, was rejected.

The question of how the three men died was debated in a number of books and newspaper articles throughout the Thirties, and after. One thing was clear: the parts of their bodies that were recovered bore no traces of external injury.

In 1952 a Danish doctor, E. A. Tryde, published a book, *The Dead Men on White Island*. He had read Andrée's diary and paid close attention to the symptoms described whenever Andrée noted that one of the men felt ill. Tryde discovered that quite early in the journey across the ice they had suffered from fever, cramps, diarrhea, stomach pains, muscular pains, rashes and small boils. In Tryde's opinion, the combination of these symptoms indicated that their illness was trichinosis contracted from polar-bear meat—which they could not have cooked very thoroughly on their Primus stove and which, as Andrée notes in his diary, they occasionally had eaten raw. If that was so, the bears that kept them alive also did them in.

Andrée was a wise and practical civil servant, but in his enthusiasm he made one unwise decision: to try to reach the North Pole in a hydrogen-gas balloon. The expedition was doomed from the beginning and, somewhere along the way, he must have realized it. Yet, with all the unanswered questions, Andrée, Strindberg and Fraenkel occupy a secure niche in the history of polar exploration although their bold venture set no precedents. No later explorers—Amundsen, Peary, Byrd—ever tried to reach the poles by balloon.

Andrée had set out two decades too soon with technology that was still far too primitive. In the *Eagle*, he had to go where the balloon took him. Literally, he had cast his fate to the winds.

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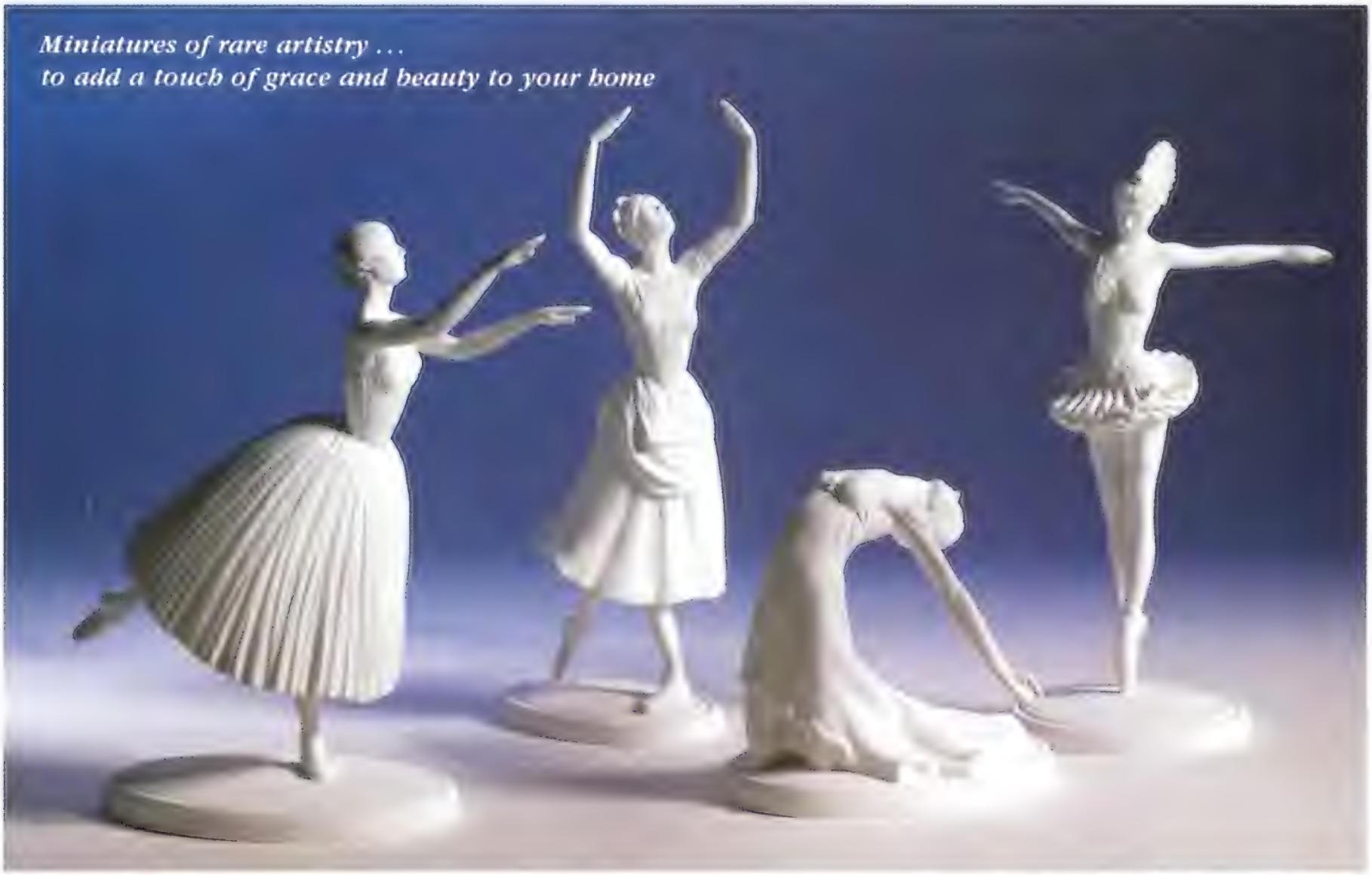
Bodies of the three men were returned to Stockholm aboard the *Svenskund*.



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Book reviews

Confidence Men and Painted Women: A Study of Middle-Class Culture in America, 1830-1870
Karen Halttunen
Yale University Press, $19.95

How can you tell whether to trust a stranger? Granted that appearances are important, how can you improve your image? Isn't it more honest to act natural? But how do you act natural? If there are telltale ways, won't hypocrites imitate them? How can we be completely honest and still make people like us?

These may sound like the current topics of encounter groups, singles bars, talk shows, coping books and other such arenas of modern philosophical debate, but they are, in fact, traditional American etiquette problems, endemic to a mobile meritocracy.

They are also insoluble. Once you accept the ideal of judging people solely on their merits and approve of their rising from one social class to another (and you can't trace their records or origins, anyway, because they move about too often), manners, including behavior, speech, clothes and social patterns, come to be considered important clues to character. Eventually, then, some people notice how rewarding it is to assume the approved superficialities, and others learn the risks of trusting their hearts and/or purses to strangers.

Karen Halttunen's fascinating and well-written book shows us these problems. Then, as now, there was a general antipathy to the sophisticated view that artificiality is sometimes more attractive than naturalness or plain honesty.

In the America with which she opens

the book—the 1830s—static, hierarchical, rural and small-town life was giving way to the peer-ruled "urban lottery." The presumed reader of advice books was a young innocent seeking his fortune in a strange city, without benefit of tradition or parental supervision, and therefore prey to the wiles of the clever confidence man who profited by leading him into a life of fast-buck wheeling and dealing.

But by the late Victorian era it became apparent that what the young entrepreneur needed was not so much protection from confidence men as tutoring in their techniques. The dread deceiver with his satanic charisma was lauded as a self-made man, admired for his executive ability to influence others, and now the model, rather than the villain he had been in the early Victorians' advice books.

Advice-givers, accepting the realities of the business world, shifted their hope of preserving the perhaps mythical American simplicity to the home, under the care of women, who were to have the luxury of remaining pure (while being materially supported by the clever efforts of those businessmen). But the villainess of the hearth—the painted woman who corrupted that precinct through her devotion to the frivolity of fashion—evolved into the admired star of society's increasingly frank enjoyment of theatricality: image-making through dress.

How is it that such earnest soul-searchers as the early Victorians came to be known to future generations as arch-hypocrites? Their cult of "sincerity," comparable to today's constant evocation of "honesty," included the traditional American faith that every detail of life can be made to con-

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form with prevailing philosophy. There were fashion magazines extolling "sincere" styles of clothing, etiquette books documenting the "sincere" medium between callous and ostentatious mourning practices, and model letters demonstrating the "sincere" modes of expressing sincere ardor.

The difficulty, Halttunen suggests, may be in their confusion between the natural and the ideal. But that gave them a better reason than we have for wanting it all to hang out ("transparency," meaning openness or candor, was the term in vogue), as they believed that "it all" would prove virtuous and beautiful and serve as a unifying standard of behavior in a rapidly changing society.

At any rate, it didn't work. Once sincerity was documented, and the fixed formulas governing gentility established, any rogue could take them up, and those who wanted to protect virtue were back where they started.

We are left with a heritage which has us simultaneously proud of our ability to manipulate images, and distressed over our confusion about what jeans, bumper stickers and hair styles truly signify.

Judith Martin
Novelist and author of the syndicated "Miss Manners" column

The Canine Clan: A New Look at Man's Best Friend
John C. McLoughlin
Viking Press, $15.95

At times it seems that the number of books about dogs is exceeded only by the number of dogs. Very few of these books rise above the level of an inventory of breeds or a rambling discourse on the latest fad in training. It is hard to write a good dog book. The author must balance scientific fact, informed speculation and a good measure of genuine affection.

One of the last books to accomplish this was Konrad Lorenz's classic *Man Meets Dog*. His anecdotes remain entertaining and insightful, but many of the scientific views he expressed have had to undergo drastic revision. In *The Canine Clan*, John McLoughlin provides us with a new work that deserves to replace *Man Meets Dog* as *the* popular, yet scientific, treatise on one of our most familiar mammals.

Most attempts to trace the history of human association with dogs pick up the story at a time when wild canids began

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Mastiff in mail: in medieval times, dogs often saw duty on the battlefield.

lurking around the campfires of our hunter-gatherer ancestors. McLoughlin pushes the story back 300 million years. He begins with the rise of the synapsids, the reptile-like ancestors of the first mammals. He is very much at home in this era, having detailed the diversity of life at this time in his earlier book *Synapsidia*. From here we travel to 200 million years ago, when the shrewlike descendants of the synapsids began to live under 140 million years of dinosaur oppression. This is not an idle digression into paleontology. McLoughlin demonstrates how the mammalian mind was molded by competition with the dinosaurs, becoming adapted to a nocturnal niche in which odors were the primary source of information about the world.

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The canids became successful through adaptations that eventually made possible their close association with Man. These include omnivory, mobility, cooperative foraging and a tendency to form close social bonds. These qualities are very strong in the wolf, the likely progenitor of all dogs.

Owing to the close similarity of many wild and domestic canids, it is difficult to determine exactly where and when the process of domestication began. The

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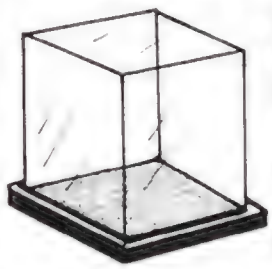

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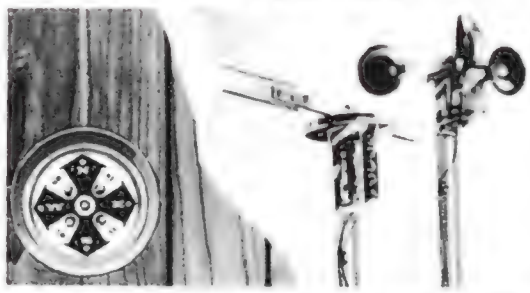

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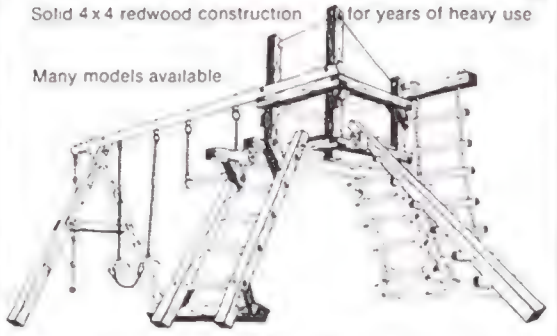

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author gives a good review of the differences that paleontologists and archaeologists look for in trying to distinguish between the remains of true companion canids and those of camp scavengers. The resulting conclusions are conservative, but scientifically sound. Most of the characteristics associated with domestic dogs appeared simultaneously throughout Europe and Asia Minor between 14,000 and 12,000 years ago.

The Canine Clan becomes disappointingly simplistic in its treatment of the actual process of domestication. It presents the conventional story of the wolf's transition from nemesis to scavenger to hunting companion. McLoughlin has not given the same attention to the literature of the "psychology" of domestication that he has to its paleontology. Studies of contemporary hunter-gatherers indicate that dogs are often more of a burden than an asset in hunting. Australian Aboriginals often wind up carrying their exhausted pooches back to camp, where they serve the primary purpose of keeping their masters warm at night. In addition, wolves frequently rely on sustained pursuit of rapid prey through relays of pack members. This style of hunting does not lend itself to human participation.

Such evidence suggests that we consider other alternatives to explain the start of domestication. It is possible that the process began for reasons unrelated to ecological practicality, such as ritualistic or totemic practices or even a basic human tendency to show a parental interest in mammalian infants, eventually leading to their adoption and integration into human society.

There is obviously a great deal of difference between contemporary dog breeds and their wild ancestors. McLoughlin explains the diverse genetic and physiological changes, such as acromegaly and achondroplastic dwarfism, that have generated such a range of forms. Each breed, he notes, "represents an isolated subset of wolf genes sieved from the whole by human intervention." The final chapter argues strongly for the preservation of the undomesticated branches of the canine clan that have provided us with creatures capable of love and loyalty.

Randall Lockwood
Assistant professor of psychology
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Distant Water: The Fate of the North Atlantic Fisherman
William W. Warner
Little, Brown, $17.95

The 30-year rule of the seas by factory trawlers, huge ships roaming long and far asea in their insatiable search for fish, is near its end. Elegantly engineered with electronic fish-finders, nets three football fields long and, below decks, filleting, freezing and fish-meal-grinding plants, these water dinosaurs were singularly well adapted to prey on favored eating fishes that once abounded in the North Atlantic. They came in numbers as well as size. William Warner describes their heyday as "rows of 200 or more factory trawlers plowing the best North Atlantic grounds like disk harrows in a field."

Trawler Rex's reign was short but ruthless, sweeping the halibut, capelin and many other species to the brink of commercial extinction. To protect fish and fishing industry alike, many nations have set up 200-mile fishing limits in the last half-decade. As a result, Warner finds, "the fishing commons of the oceans have been enclosed," the factory-fishing behemoths hopelessly overspecialized.

The demise of these fish-killing factories has been little noted and is scarcely mourned. American and Canadian fishing industries have rebounded in recent years, haddock stocks have risen fivefold and cod numbers doubled since 1974. But if the giant trawlers' passing is not rued, it is documented, thanks to the diligence of William Warner. And, owing to his mastery of style and substance, the story is as captivating as and far more accurate than any fisherman's tale of the ones that got away.

Warner is no stranger to the task of documenting fishermen's lives. His 1976 account, *Beautiful Swimmers: Watermen, Crabs, and the Chesapeake Bay*, was a Pulitzer Prize-winner. Nevertheless, he found life aboard the Soviet, West German, British and Spanish trawlers that he visited "far removed from other forms of seafaring and indeed from all normal human experience." Among their crews he found common decency and uncommon dedication to long hours of back-breaking labor amid the cruel conditions of the winter Atlantic. Despite universal carping, all clung to the high wages and dangers of their oceangoing lives.

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But it is the differences, rather than the similarities, among trawlers that fascinate most in Warner's narrative. Aboard the *Wesermünde*, he found the West Germans every bit the master fishermen their rivals find them. In far less favorable surroundings, British deckhands aboard the cramped *Kelt* went about their duties feverishly with the unselfish dedication of combat troops. On the aging Spanish trawlers *Terra* and *Nova*, paired to haul a wasteful half-mile-wide net between them, Warner found superstitious Spanish bosuns working round the clock with Keystone Kops efficiency. By contrast, Warner's last hosts, the crew of the Soviet *Seliger*, were well fed and rested (eight hours on, eight off for five months at sea), enthusiastic ("the most highly motivated crew I had seen") and hospitable.

With prime fishing grounds now closed or fished out, the *Seliger*, Warner fears, is a ship that has lost its mission. Life aboard the other supertrawlers of the North Atlantic cannot be much happier. The *Kelt* has been converted to oil prospecting. The *Wesermünde* makes only occasional fishing forays, among them voyages to the foul-weather "rock gardens" of the eastern coast of Greenland. Only the *Terra* and *Nova* still linger on the margins of our coastal grounds, scrounging for about one-third their joint capacity each journey.

Warner himself endured much to chronicle the last days of the distant-water dinosaurs. He survived the Normans' flying dishware, Russians' raw eels, Spaniards' cuisine and his own bad back, as well as the formidable hazards of foreign languages and technology. All of these he has weathered, and he has come ashore with a treasure far richer than his own modest hope for a book "within tolerable bounds of general interest."

Don Lessem
Naturalist and writer

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Richard Cobb
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enough traditions and institutions to sustain a sense of continuity with the prewar Third Republic. Despite the humiliating defeat of the French army, the collapse of the French government, the division of France into an occupied zone and a zone ruled by Frenchmen willing to do the occupier's bidding, it was the Germans' policy that life be made to seem to be going on much as before. The Occupation's impact was all the more insidious, Richard Cobb makes clear, for not always swaggering about in jackboots.

Cobb knows France and the French as well as any foreigner. Most of the Oxford historian's scholarly work has dealt with aspects of the French Revolution, but he has lived in France intermittently since the 1930s, and in recent years his writings have ranged widely over contemporary French society, politics and culture.

Largely based on a series of lectures at Brandeis University and at Oxford, *French and Germans, Germans and French* retains the repetitive, rambling, discursive quality of an informal talk—and also the lopsidedness: the occupation of France in the 1914-18 war, far less well known than the later episode, takes up only one-fifth of the book.

Cobb is a spellbinding raconteur, but he assumes his audience knows more French history than may be the case. Readers puzzled by the allusiveness of these essays can turn for elucidation to Robert O. Paxton's already-classic *Vichy France: Old Guard and New Order* (Norton, 1972), on which Cobb also relies, and whose judgment on Vichy essentially agrees with his: "a dishonourable, equivocal and ludicrous régime."

Cobb asks the key questions about France under German occupation—the answers to nearly all of which are painful. Nothing better illustrates this than the word "collaboration," forever stained with the low and dishonorable deeds committed under the Occupation of 1940-44. It is an elastic concept, one that stretches over conduct of the most diverse kind. Was the peasant who sold eggs to German soldiers a collaborator? What about the Métro conductor whose subway cars mingled French and German passengers?

Some writers are now eager to hold the French to a very strict standard, but Cobb doubts that inconsequential—indeed unavoidable, if one was to get on with everyday life—encounters between occupiers

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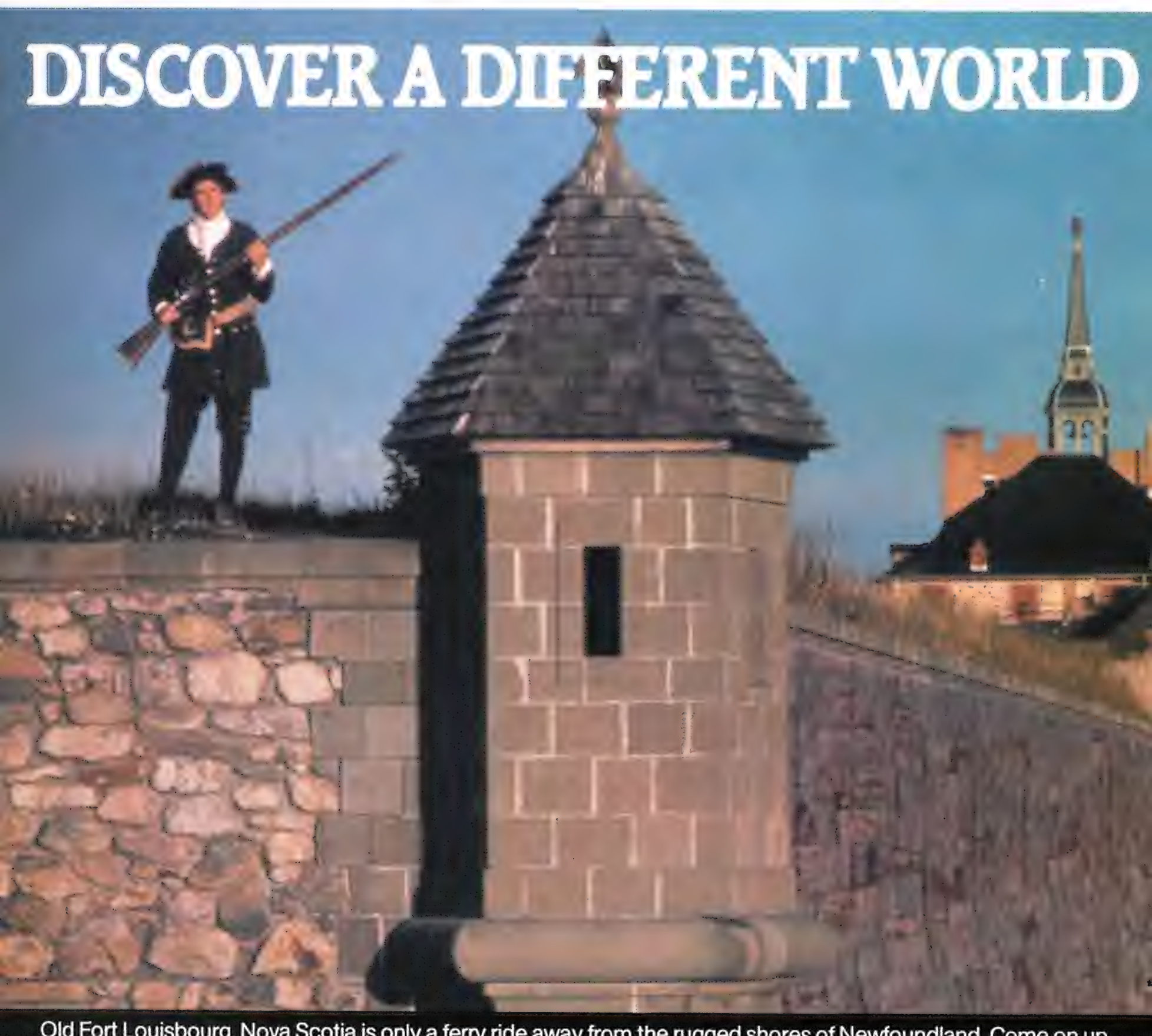
and occupied deserve to be labeled collaboration, any more than thinking wicked thoughts about the Germans constituted membership in the Resistance.

Real collaboration could run from love affairs between occupier and occupied—which almost invariably ended badly, given the precarious conditions of wartime—through collusive black-marketeering between French gangsters and the German supply corps, to a kind of sporting competition between the torturers of the French *Milice*, the paramilitary Vichy police that probably enlisted as many members as the Resistance, and those of the Gestapo.

Collaboration*ism*, Cobb suggests, was "a more public and political form of collaboration." The most conspicuous of the collaborationists—certainly the most narcissistic and posturing, in Cobb's view—were the French Fascist intellectuals, such men as the novelists Drieu la Rochelle, who would—and did—try anything once; Marcel Déat, the eternal, hyperintellectualizing *lycéen*; and Lucien Rebatet, so filled with contempt for himself and his countrymen that he longed to be a German Nazi, not merely a French one.

Only someone as sure of himself and his subject as Cobb could write "There is apparently no limit to the conceit—and to the humourlessness—of a French intellectual, ever ready to pontificate in public on this issue or that." Nothing more than the urge to get into print, he suggests, explains the eagerness, in the spring of 1942, of so many members of the intellectual elite to jump on the Nazi regime's propaganda wagon and to denounce the crimes of Britain and the British government.

Why did men and women commit themselves to collaborationism? In retrospect, this is one of the hardest questions of all to answer. "Among the French," Cobb says, "one could at once distinguish between the tenacious careerists and ad-



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venturers eager to push themselves forward to meet the more menial needs of the occupying power . . . and the convinced idealists, however confused, flawed or odious the causes of their commitment (anti-Semitism, antiparliamentarianism, elitism, the cult of leadership, corporatism, anglophobia, anti-Communism after 1941, and antifeminism)." For the ambitious who streamed back to Paris once the dust of defeat had settled, the rule of the Germans meant a new deal—careers open to talent, they might have thought, in a way that had not been possible since the Great Revolution.

It is remarkable how much ground Cobb's short book covers, poking into aspects of life under the Occupation that most historians have ignored. Cobb's notion that death is the one thing Fascists and Nazis are good at is probably as economical and accurate a concept of them as anyone has laid down. And in a passage evocative of Albert Camus' *The Plague*, which some have read as an allegory of the Occupation, Cobb describes the *other* occupiers, the ones who had always been there—the battalions of huge rats driven by wartime privation up from the sewers of Paris, scurrying swiftly through the nighttime streets, congregating and fighting around the especially bountiful garbage bins set outside hotels and restaurants reserved for Germans.

Living under a foreign occupation is as remote from the experience of most Americans as walking on the moon. The English, last successfully invaded in 1066, haven't any better idea of an occupier's rule. But no Anglo-Saxon (to use General de Gaulle's omnibus term) will be able to read Cobb's book without asking himself what is perhaps the central question of all: in similar circumstances, what would *I* have done?

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Additional reading

Birth of the Universe (p. 32)

The First Three Minutes by Steven Weinberg, Basic Books, 1977

"Gauge Theories of the Forces between Elementary Particles" by Gerard 't Hooft, *Scientific American*, June 1980

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John Constable (p. 52)

Constable the Natural Painter by Graham Reynolds, McGraw-Hill, 1965

Memoirs of the Life of John Constable by C. R. Leslie, Cornell University Press, 1980

Constable: The Painter and his Landscape by Michael Rosenthal, Yale University Press, 1983

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The Dark Side of the Landscape: The Rural Poor in English Painting 1730-1840 by John Barrell, Cambridge University Press, 1980

Living Horse Museum (p. 62)

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Chantilly: Histoire du chateau et de ses collections by Raoul de Broglie, Calmann-Levy (Paris), undated

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In the Ring of the Rise by Vincent C. Marinaro, Crown, 1976

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Fisherman's Bounty: A Treasury of Fascinating Lore and the Finest Stories from the World of Angling, edited by Nick Lyons, Crown, 1970

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Smithsonian highlights

Works by 100 artists from 29 states will be exhibited and on sale at the Washington Craft Show, sponsored by the Smithsonian Women's Committee. Fiber, ceramics, wood, leather, glass, cloth (p. 153) and many other media are to be represented. "It's a very powerful show," says juror Lloyd Herman, director of the Renwick Gallery. "Exhibitors have translated techniques into new forms and combined media in exciting new ways, producing paper that looks like rawhide, glass that appears to be fiber and ceramics as delicate as lace."

The show will be held May 6 and 7 from 11 A.M. to 9 P.M., and May 8 from 11 A.M. to 6 P.M. at the Departmental Auditorium, 1300 Constitution Avenue. Admission is $4.50.

Special May exhibits and events

National Museum of Natural History
The Silk Route and the Diamond Path (May 6-June 30) Buddhist bronze, stone, terra-cotta and wooden sculptures from the great Central Asian trade routes.

National Air and Space Museum
Heinemann's Hot Rods (May 20; 8 P.M.) Aircraft design genius discusses his A-4 Skyhawk and other creations.
New Eye on the Universe (May 18; 7:30 P.M.) Talk given by CIT physics professor Gerry Neugebauer on the Infrared Astronomical Satellite.
Counting Days and Years (May 7; 9 A.M.) Monthly sky lecture.

Museum of African Art
African Art in Color (May 18-October 6) About 150 pieces from sub-Saharan Africa illustrate rich and varied pigments.
From the Earth: African Ceramic Art (May 18-October 9) Survey of clay work.
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National Museum of American History
Building Brooklyn Bridge: The Design and Construction, 1867-1883 (May 4-mid-September) Original drawings, photographs.
With These Hands (May 4-5; 12:30 P.M.; Carmichael Auditorium) Hour-long film on eight American artisans.

Cooper-Hewitt Museum (New York)
Canes and Walking Sticks (May 3-July 24) Survey of 250 examples includes "gadget canes" (see "Highlights continued").
Fabergé: Jeweler to Royalty: From the Collection of Her Majesty Queen Elizabeth II and other British Lenders (through July 10) More than 200 masterpieces.

Freer Gallery of Art
Japanese Ceramics from Past to Present (through August 31).
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National Museum of American Art
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Summer hours

Five museums on the Mall will remain open an extra two hours daily from Memorial Day to Labor Day. Extending their closing hours from 5:30 to 7:30 will be NASM, NMAH, NMNH, HM&SG and the castle. The parking garage, located underneath NASM, will be open 6 A.M.-8:30 P.M. daily.

The National Zoo will also observe summer hours: from April 1 through October 15, it will be open 8 A.M.-8 P.M., with buildings open 10 A.M.-6 P.M.

Smithsonian events

For price information and tickets to Resident Associate events, call 357-3030:

West Germany in Transition (May 14; 10 A.M.-5 P.M.) All-day seminar with leading scholars, led by *Die Zeit* editor Josef Joffe.

Saving the Sea About Us (May 10; 9:30 A.M.-5:30 P.M.) All-day seminar introduced by The Hon. Elliot L. Richardson, former U.S. Ambassador to the Law of the Sea Conference.

Final Curtain: An Evening with Ellen Terry, Sarah Bernhardt and Eleanora Duse (May 4; 8 P.M.) Interpretations by actress and theatrical historian Arlene Stern.

The Genius of the Brooklyn Bridge: John A. Roebling (May 24; 8 P.M.) Lecture by Princeton professor David Billington.

A Tribute to Abel Gance (May 31; June 7, 14; 7:30 P.M.) Film series features *Napoleon, J'Accuse*, other early greats.

Chopin: Sublime Spirit (May 22; 10 A.M.-noon or 11 A.M.-1 P.M.) Noon concert by pianist Edith Cornfield, with choice of early or late brunch.

Smithsonian on the air

A new series of two-minute features, "Here at the Smithsonian," is now carried on more than 40 television stations nationwide. This month's features are the aircraft carrier U.S.S. *Enterprise* and the Kikuchi collection of Japanese ceramics.

Among the May listings for Radio Smithsonian are "Happy Birthday, Brooklyn Bridge," an introduction to two new museum directors, and life in a tropical rain forest. To find out what stations in your area carry these TV and radio programs, write: Office of Telecommunications, MNH Room C222B, Washington, D.C. 20560.

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Regional events

The Regional Events Program will travel to Grand Rapids, Lansing and Kalamazoo from May 18 through May 25. The program features lectures, seminars and workshops on "Milestones of World War II Aviation," "The Art of Scientific Illustration," and "The Search for Extraterrestrial Intelligence." Associates should have received invitations by this time. For more information, write: Regional Events Program, A&I 1208, Smithsonian, Washington, D.C. 20560.

Smithsonian Institution Traveling Exhibition Service

SITES circulates exhibitions to hundreds of cities outside Washington. To sponsor a show in your community, write: SITES, Smithsonian, Washington, D.C. 20560. Here are some May exhibitions:

Juneau, Alaska (May 7-June 19) *Inua: Spirit World of the Bering Sea Eskimo,* Alaska State Museum.

Chicago (May 21-August 7) *The Vanishing Race and Other Illusions: A New Look at the Work of Edward Curtis,* The Field Museum.

Peru, Illinois (May 7-June 5) *The Shopping Bag: Portable Graphic Art,* Peru Mall.

El Dorado, Kansas (May 7-June 5) *Jupiter and its Moons,* Butler County Community College.

Chattanooga (May 14-June 12) *John Sloan in Santa Fe,* Hunter Art Museum.

Jackson, Michigan (May 7-June 5) *Perfect in Her Place,* Ella Sharp Museum.

Aztec, New Mexico (May 7-June 5) *Edison and the Electrical Age: 100 Years,* Altrurian Public Library and Aztec Museum.

San Antonio (May 14-June 12) *America's Space Truck: The Space Shuttle,* Museum of Transportation.

Membership benefits

"Planning Your Smithsonian Visit" is part of the helpful free pre-visit packet for Associates coming to Washington; send postcard request or phone Associates Reception Center, Smithsonian Institution, Washington, D.C. 20560; (202) 357-2700; for hearing impaired, TDD (202) 357-1729. Allow two weeks for receipt.

Begin your visit at the Associates Reception Desk in the castle, where your welcome includes special printed materials, 10 A.M. to 4 P.M. Other benefits: a half-hour orientation slide/lecture to the 13 museums; dining in The Court; discounts in most Smithsonian shops.

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Linguaphone

Canes that led a double life

Harboring violins, dice and gimlets, walking sticks in Cooper-Hewitt's show are anything but down-to-earth

The Italians call it *baston con anima* (animated stick), while to the Germans it is the *Stöke mit Seele* (stick with soul). In characteristic American fashion, we've dubbed it with a more prosaic name—"gadget cane." But its mystery is no less seductive.

The cane with concealed blade, poison dart or deadly serpent has long been a favorite of Victorian-mystery writers, while a fastidious French dandy used one to dispense and take in money at the gambling table, so he never had to touch the coins. But the exhibition at the Cooper-Hewitt ("Canes and Walking Sticks"; May 3 through July 24) proves that weapon and wallet canes were only the more mundane 19th-century creations. In that century, the walking stick was de rigueur for the gentleman, and many a lady, too. Writing in 1899, Thorstein Veblen observed: "The walking-stick serves the purpose of an advertisement that the bearer's hands are employed otherwise than in useful effort."

The properly equipped city dweller could—on the spur of the moment—serenade his fiancée with his violin cane, paint a picture, play tiddlywinks, or even set off firecrackers (great for those Parisian demonstrations).

For a rural jaunt, he could carry the pedometer cane, the ice-ax cane or the ladder cane. If he wandered too far, he could use his tent cane. Anglers could choose from the fishing-rod cane, the boat cane and, if the boat cane failed (one suspects it might have been among the trickier ones, with its collapsible oars and frame), he could whip out his life-preserver cane. Hunters brandished boar-spear canes and butterfly-net canes.

In this heady sweep of cultivated affectation, one just never knew when one would be struck by the spontaneous urge to make music or commune with nature. But with the right cane close at hand, one could always be prepared.

Constance Bond

Lady's cane holds lipstick, perfume; man's encases gimlet and other tools.

Spyglass on a German cane is removable for easy viewing.

For picnics, sections of these canes were transformed into cutlery handles.

Violin canes: Austrian-born virtuoso Fritz Kreisler owned the one at left.

Ear-trumpet canes sold by Franck-Valéry in Paris have earpieces that can pivot.

Dice, dominoes and tiddlywinks were always at hand for quick pickup games.

Made in Geneva in 1800, this cane combines an alarm-watch with sword.

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Domestic Study Tours

Southwest Archaeology May 28-June 6: Camping trip includes Mesa Verde, Monument Valley and river rafting.

Bryce, Zion and the Grand Canyon June 5-13 or September 6-14: Hike spectacular trails while learning about the geology, wildlife and flora of these national parks.

San Juan River June 8-16: Explore geology and archaeology on this active hiking and river-running trip through the mighty canyons of southeastern Utah.

Glacier/Waterton National Parks July 10-19 or July 18-27: Hike through magnificent scenery with overnights at park lodges.

Desolation and Gray Canyons July 22-August 1: A white-water trip for the adventurous on Utah's Green River.

Salmon River August 5-12: Idaho wilderness adventure in oar-powered rafts.

Colorado Rockies August 7-13: Dig for fossils, hike alpine meadows and explore 6,000-acre outdoor classroom in the shadow of Pikes Peak.

Grand Canyon August 12-22 or August 26-September 5: A sublime spectacle, seen on a raft trip down the Colorado River.

Isle Royale and Minnesota's North Shore August 19-28: Hike through the pristine wilderness of forests and lakes in the northwest corner of Lake Superior.

Colorado Railroad and Mining History August 20-28: Trace the colorful Gold Rush era from Denver to Durango.

Along the Bozeman Trail August 20-27: Study Northern Plains Indians history with visits to Crow Indian Fair, Custer's Battlefield, the Big Horn Mountains and Yellowstone National Park.

Pacific Northwest September 6-15: From lush rain forests on the Olympic Peninsula to quiet coves on the San Juan Islands, enjoy vigorous hikes while staying at charming lodges.

Boston September 14-18: Study the city's celebrated past and vibrant present with walking tours and visits to historic homes and museums.

Canyon & Mesa Archaeology September 16-27 or September 30-October 11: Enjoy autumn at Mesa Verde, Canyon de Chelly, Chaco Canyon and Indian reservations.

California Wine Country October 2-8: Introduction to wines of Napa, Sonoma and Mendocino with noted wine experts.

Philadelphia October 5-9: A local historian reveals an inside view often missed by the casual visitor.

Chesapeake Birds October 8-15: From Chincoteague, Virginia, to Cape May, New Jersey, observe vast flocks of migratory birds.

Washington "Anytime" Weekend: An economical and convenient way to visit your choice of Smithsonian museums. Package includes hotels, meals, Tourmobile and exclusive tour of Smithsonian castle. Application and payment must be received at least ten days prior to arrival.

Foreign Study Tours

These tours range in size from small group experiences to charter adventures and vary in price from low cost to deluxe, depending on the type of travel, destination and length of trip:

People's Republic of China 1983: Climb China's sacred peaks, cruise the Grand Canal, explore the back roads, or study decorative arts and antiques. Thirteen exclusive tours are led by Sinologists and include intensive pre-tour briefing.

Odyssey of Flight May 22-June 6: National Air and Space Museum experts lead a grand tour of British and French aviation museums and private aircraft collections, plus the Paris Air Show.

Alpine Countryside May 28-June 12 or September 10-25: Study folk art and architecture, flora, fauna and geology in a charming Austrian mountain village.

Cotswolds Countryside June 26-July 10 or July 10-24: Stay in Cirencester, in the midst of England's ancient green hills. Visit archaeological sites, market towns, woolen mills, museums and private homes.

European Waterways July 12-24: After two days in Paris, board the *Argonaut* in Rouen. Visit museums in Bruges and Amsterdam before cruising the Kiel Canal to Copenhagen.

Sailing the Greek Islands August 25-September 7: After three days in Athens and visits to Delphi, Mycenae and Corinth, board the luxurious four-masted yacht *Sea Cloud* for the ultimate seafaring adventure including Delos, Santorini and Asia Minor.

Paris and Provinces August 28-September 11: Six days in Paris followed by an excursion to Provence or Burgundy.

Oxford/Smithsonian Seminar September 9-24: Live in medieval or modern "digs," dine at high table, and enjoy the special ambience of this famous university town. Oxford faculty lead classes and field trips in art, literature, history, archaeology, manuscripts, and science and belief.

Black Sea Passage September 11-24: Follow the ancient route of Jason and the Argonauts, cruising from the Aegean to the Black Sea. The *Argonaut*'s ports will include Nessebur, Bulgaria; Constanta, Romania; Odessa, Yalta and Istanbul.

Scotland September 23-October 7: Special walking tours in Edinburgh plus visits to castles, abbeys, battlefields, archaeological sites, and enchanting countryside.

Egypt and the Nile October 3-21: Visit Cairo, then cruise aboard a chartered river ship to explore renowned sites.

Journey to Asia Minor and the Aegean Islands October 9-22: From Athens, join experts aboard the *Illiria* for a study voyage to important historic and archaeological sites. Fall is the perfect season for visits to Rhodes and Santorini and calls at the Turkish cities of Antalya, Bodrum and Izmir.

Portugal October 18-November 1: Enjoy Lisbon's diverse charms and gentle character; sample the rich variety of the historic coastline and hinterland.

Japan October 23-November 9: Extended program in historical Kyoto and Nara followed by a choice of travel to the Inland Sea or the Sea of Japan.

The Atlantic Crossing December 3-18: A sailing adventure from the Canary Islands to Martinique on the *Sea Cloud.*

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Selected Studies Seminars

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Connoisseurship of American Ceramics September 25-30: Well-known writer Elaine Levin and Lloyd Herman, Director of the Renwick Gallery, focus on the unique historical development of American forms. Highlights include a special exhibition at the Renwick Gallery and visits to studios.

Genealogical Research October 9-14: Taught by Milton Rubincam, Marilyn Duncan and other leading authorities, participants learn how to conduct research in major genealogical repositories.

Lost America: Myth and Reality October 2-7: Dean Snow, renowned author, archaeologist and consultant to the National Geographic Society, discusses in generously illustrated lectures important archaeological sites in the news today, including the great burial mounds, gigantic systems of geometric earthworks, and the temple builders who were inspired by Mesoamerican cultures.

World War I Aviation October 16-21: World-renowned experts Jack Bruce, Peter Grosz, Walter Boyne, Donald Lopez and others from the National Air and Space Museum shed new light on the brave pilots and the evolution of their aircraft.

Aircraft Restoration: How To October 23-27: The master craftsmen of the National Air and Space Museum share their many techniques in workshops at the Paul E. Garber Facility (Silver Hill).

American Antique Furniture October 23-28: Connoisseurship of masterpieces, 1650-1840. Includes great collectors, detection of fakes, care of antiques and tours of Winterthur Museum and the Diplomatic Rooms at the Department of State.

Quilted Clothing November 6-11: Lectures and workshops with noted designer and author Virginia Avery, who provides designs, ideas and guidance.

Irresistible Magazine Writing November 13-18: Lectures and creative workshops with Edwards Park, lively, irreverent originator of the *Smithsonian* column "Around the Mall and beyond."

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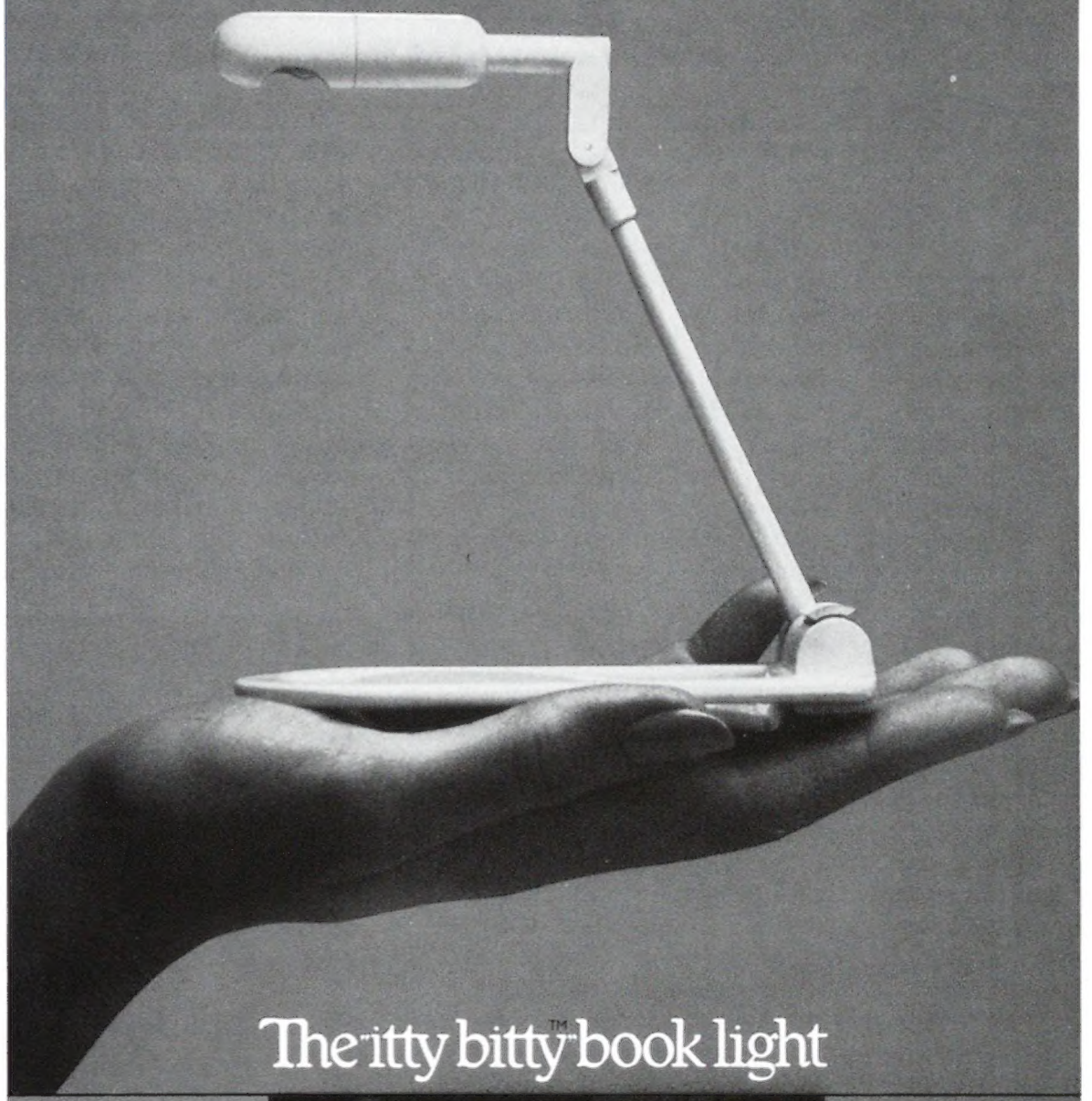

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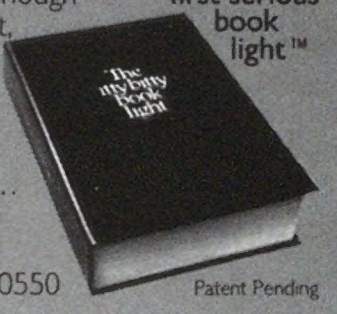

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Patent Pending

By Richard L. Williams

The prose and cons of fortune cookies

Some collectors collect collectibles. Not my wife; she collects stuff that no collectible collector would have around the house. Chinese fortune cookies, for instance. Well, not the cookies, really, but the fortunes—those one-liners that come on the slips of paper inside. My wife does not remember *why* she started her collection. Maybe nostalgia for the days when you dropped a penny in the drugstore scale and out came a tiny ticket, not only telling your weight but your future. She simply got a small Chinese-looking notebook and began pasting in the fortunes.

That was in 1949. Since then the fortunes have always been heavy on variations of celebrated themes ("There is nothing permanent except change") and puns that might appear as one of those fillers in the *Reader's Digest* ("Love is a softening of the hearteries"). Some show cynical wisdom ("The secret of happiness is to get what you want"). A few even demonstrate a touch of peasant genius: "Don't argue with your bread and butter. Enjoy it."

Reviewing these seminal texts from a 35-year perspective, though, we came to the conclusion that fortune-cookie prose ain't what it used to be. My wife's favorites are invariably what she thinks of as the oldies: "Age is like love, it cannot be hidden." Or "You need more than dancing shoes to be a dancer." Or "Money spent on the brain is never spent in vain." And "Better be alone than in bad company."

Not to mention this charmingly inscrutable item collected back in 1963 after shrimps with black-bean-and-garlic sauce at Sun Luck in New York: "Smile—people will wonder what you are up to."

By contrast, strips of print acquired more recently are pretty banal, as well as consumer oriented. Indeed, it is hard not to think that an inferior grade of literary coolie is now at work: "Lady Luck is with you today!" "Your present plans are going to succeed." "You will live in splendor and plenty." And (ho, hum) "It's a sure bet, you'll be a big winner." Even new cookie puns have a clunky sound: "You will be chosen someday to go to the moon, because in school you took up space."

These days, too, fortune writers manage to sound wordy, a real trick when you're composing for a ribbon of paper two inches long and only one-quarter-inch wide: "Worrying about tomorrow doesn't take away potential sorrow, it only takes away the joys of today."

Maybe it's mass production. Maybe. But anyone trying to get a hard critical fix on the genesis of fortune-cookie prose is soon lost in a subgum of speculation. Fortune cookies seem to be a 20th-century Sino-American invention. Just who *did* invent them remains shrouded in Oriental mystery, even though fortune-cookie boxes packed for the China Bowl Trading Company in New York come with a lot of cookie lore: "The history of messages in cakes," the box asserts, "goes back to the 13th century in China when the people were oppressed by the barbarian rule of the Mongol conquerors. In those days, instructions calling for local uprisings and attacks on guards were transmitted on rice paper in steamed cakes."

The China Bowl sells a half-million fortune cookies a year. It gets them from the Key Key Cake Company, so we called them up and got in touch with Key cookie expert Phil Leung. Mr. Leung casts a cold eye on any theory about a rise or fall in the quality of fortune-cookie prose. "We have a thousand or more sayings, all numbered," he explains. "Many date back to Confucius. When we need more we just tell the printer which numbers we want."

Recycled from this timeless Confucian cache, the rerun sayings come off the press, hundreds at a time, and are snipped into individual messages. Then the bakers fold the still-hot and malleable cookies around each snippet of prose as the cookies pass along an assembly line.

Does that basic stew never get an infusion of new prose? "People call up sometimes and complain that we need new fortunes," Leung admits. "We answer 'Go ahead, send us some.' The 15 or 20 cookie-baking places in the United States are all glad to have fresh sayings."

For fortune-cookie connoisseurs, a shattering truth soon emerges. Fortune-cookie bakers don't *pay* for new sayings. But at least they read them. China Bowl's Dick Sanders recalls a batch of new fortunes so fresh as to be practically pornographic. Short of a mass cookie-fortune burning, nobody knew what to do. Then some unnamed genius shipped them off to a restaurant in Alaska and they were never heard from again.

Anyhow, I'm trying to persuade my wife to join me in collecting something else. Something more substantial, something with more nourishing prose. Menus maybe. I already have one from the Empire Diner on Tenth Avenue in Manhattan. Below its daily listing of hamburgers, with or without French fries, is printed: "Open 24 hours. American Express accepted for checks of $15 or more. No personal checks accepted. Be nice. Don't shout. Stop scratching. Sit up straight. Smile. Don't toy with your food. Elbows off the table. Close your mouth when you chew. Cheer up. Eat your vegetables. Use your napkin. Have a nice day. Take care. Don't be a stranger. Murray, call your mother."

What fortune cookie can top that?

"Keep these lands free
from intruders."
Thus, the King's command centuries ago.
And once each year, men and women
of the Scottish Borders ride
the "marches," the boundaries of
their common lands.
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